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Improved Milling Machine.

The cut presented herewith is of a new milling machine recently brought out by The Lodge & Davis Machine Tool Co., Cincinnati, Ohio. It is made in three styles—plain, back-geared, and back-geared with universal head and index centers, and embodies features of construction which are novel and worthy the attention of our readers.

The spindle bearings are tied together by an arch, which is cast solid with the uprights and column, and the front of which is bored to receive the overhanging arm for the outer center support. This construction makes it easy to remove the arm when it is desired to do so, by simply loosening the two clamp bolts shown. The bearing of the arm in the arch is 12″ in length.

The boxes are made in halves, of bronze, and, instead of the usual flanges at each end, have a deep rib running around them in the center of their length. This rib fits tightly into a groove, which is formed in the column and box cap, the groove being bored out in the columns and caps simultaneously by specially constructed tools. This makes a box which can easily be replaced by any one who has facilities for doing a good job of simple lathe work, as the entire outside surface of the boxes can be turned off without reversing the arbor in the lathe, and thus the alignment of the spindle restored at any time. Each box is adjusted by means of a screw of large diameter placed above the cap.

The cone pulley is placed with its smallest step towards the front, in order to allow bringing the bracing for the main bearing support as close as possible to the box, and thus secure the greatest rigidity. The spindle is of forged steel, and the bearings are 4¼″ and 3½″ long.

The table has a vertical movement of 15″, and the top of the table can be raised to the height of the spindle center. The saddle has 5″ of motion to and from the column, and it can be clamped solid to the knee by means of the screw shown at the right hand side of the saddle, thus obviating the necessity for disturbing the gib screws, and also being more convenient.

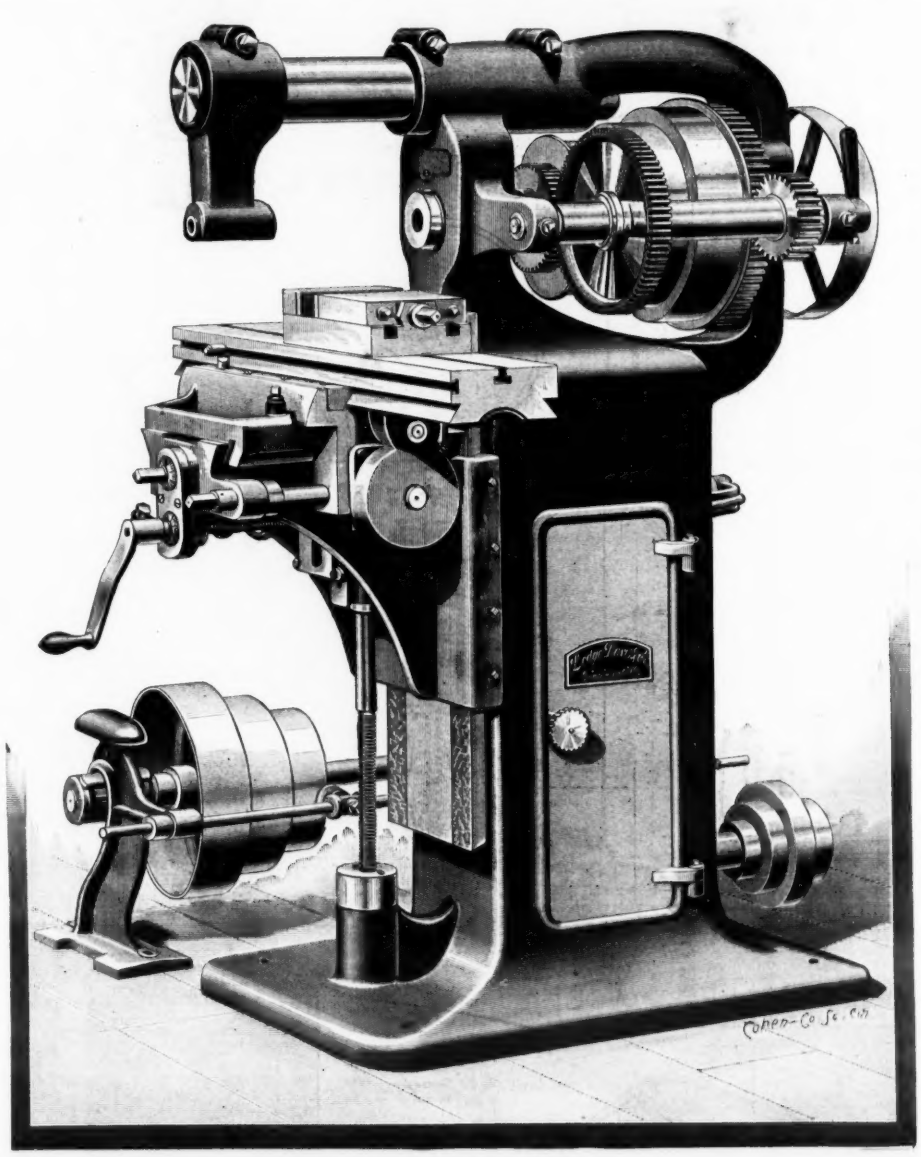
All three movements of the table are effected by the same hand-crank which fits onto either of three squared shafts which are grouped together in a convenient place, and the crank handle can be clamped onto them when desired.

Instead of the usual devices for the feed of the table, there is under it, and in the center of the saddle, a bronze screw, 12″ long and 4″ in diameter. The threads of this screw engage with spiral teeth, which are hobbed out in the bottom of the table, and extend along it from end to end.

By this means a strong feed mechanism is obtained, and the thrust is brought as close to the top of the table as possible. The train of gears for revolving this screw, and thus feeding the table by hand, is distinct and separate from the train used for power feeding, and, when moving the table by hand, one revolution of the crank gives a movement of just one inch to the table. This construction admits of a table of any desired length with a feed the entire length of it, and it can be taken out at either side of the saddle without removing or disturbing any other part. The table is 6¼″ wide and 32″ long.

Motion is carried to the feed train by means of the well-known universal joints, and the feed is tripped automatically in either direction. All gears and other feed mechanism are covered by shields, to exclude chips and dirt.

The machine illustrated is driven by a 3″ belt, the largest step of the pulley being 11″ diameter. The plain machine (without back gears) is driven by a 3½″ belt, the largest step being 13″ diameter. The machine weighs 2,000 pounds.



IMPROVED MILLING MACHINE.

We notice an attempt in some quarters to discredit Labor Day as tending to foster class distinctions. Of all silly things, this is especially silly. Labor is a good, honest word, and there isn't the slightest objection in the world to doctors, lawyers, ministers, and those splenetic editors who object to calling things by their right names, "joining the procession" on Labor Day. The idea of holiday exercises in which all are at liberty to participate breeding class distinctions is too absurd to be seriously considered.

Force, Motion and Work.

BY PEDRO.

FIRST PAPER.

The object of this and some of the following papers is to discuss the questions relating to the subjects at the head of this paper in such a manner, if possible, as to bring them within the comprehension of the ordinary mechanic and enable him to solve such problems, relating to them, as he may ordinarily meet with in his business.

What is force, what is motion, and what is work, when considered from a mechanical standpoint? These have always been perplexing questions to the student of mechanics, if we are allowed to judge from past experience. In appealing to the professor for explanations of some of the vague terms used in text books, the student is often disappointed, and left in the dark by hearing a reiteration of such meaningless terms as *quantity of motion*, *momentum*, *vis viva*, *moment of inertia*, *etc.* As a definition of inertia, the first law of motion is repeated to him, which is based upon a general property of matter. Next he hears of *moment of inertia*, where the term inertia is used as a definite and measurable quantity, but when, where and how "inertia" has changed from a general to a definite property, he is not informed. He is told in a dignified manner that the moment of inertia of any body is the product of its mass into the square of its radius of rotation; but why this is so, and what law leads to this rule, remains an unknown quantity in the student's mind, to be disposed of in the best way he may be able to contrive for himself.

The natural order in which the phenomena take place is, as stated in the title, viz., first we have *force*, then *motion*, and the result is *work*. It would seem, then, that this would be the natural order in which the three main subjects should be discussed; but the first of these, force, is itself a function depending partly upon motion for its value, hence the subject will be better understood by the student if he will follow us in this order; first, motion; second, force; and third, work. We will, then, take up as our first subject,

MOTION.

Motion, as every one knows, is a general term, meaning simply the opposite of rest. Any body, as a ball, for example, is at rest while it does not change its position in reference to the earth;* that is, while the distances of the ball from any three points, fixed on the earth, and not in the same straight line, remain the same. We say three points because it takes at least three to fix the ball. For example, the ball may change its position any number of times and still remain a fixed distance from *one* point as long as it remains on the surface of a sphere whose center is the point itself. Again, the ball may remain a fixed distance from each of two points, and still occupy any number of positions on the circumference of a circle whose center coincides with the line which passes through the two points, and its plane being at right angles to the line. There can be any number of points chosen on this line, which will always be the same distance from the ball, no matter what position on the circle the ball may occupy; but if, in addition to any two points on this line, we choose a third one not on this line, and fix the distance between the ball and each of these three points, then there is but *one position* that the ball can occupy. When these conditions are fulfilled, then the ball is said to be at rest, or it does not move. When one, two, or all three of the distances are continually changing, then the ball is said to move, or to be in motion.

The fact that the ball, or any body, is in motion, gives us no knowledge of the motion beyond the fact that it is not at rest. In order to gain a definite knowledge of the motion we must know in what kind of a path the ball moves; that is, whether it moves in a straight line or in a curve; if a curved line, what kind of a curve? Second, we must know in what direction the ball moves, and third, how fast does it move? The first two questions are easily answered in any given case. To answer the third—how fast does it move?—we must know the distance the ball has moved

* We will not consider the motion of the earth, and reduce our discussion to points of absolute rest, nor will we consider any other scientific refinements which are not usually taken into account in practice.

in its path, and also the time it occupied in moving over that distance. For example, we would not feel much enlightened if we were informed that a passenger train and a stage coach have each moved or traveled from Boston to Albany, a distance of two hundred miles; but if we are also informed of the length of time required for each to travel this distance, then we have some idea how fast each has been moving. We would say that the one which traveled the distance in the shorter time has moved the faster. By dividing the distance by the number of hour occupied in moving over the same, we get the number of miles traveled in one hour. If the train was four hours, and the stage coach twenty-five hours in traveling the distance, then the former traveled fifty miles in one hour, and the latter eight miles in the same time. This is the usual, and the best way of comparing motion, viz, by the distance the body moves in one unit of time, as one hour, one minute, or one second, as the case may be. This distance is called the *speed* or the *velocity* of the body. Hence we have the definition: *The speed or velocity of a moving body is the distance over which it moves in one unit of time.**

This definition strictly applies only to *uniform motion*. When the motion is not uniform the definition must be somewhat modified. This we will consider further on.

There is no fixed unit of time. Sometimes the *hour* is adopted as the unit of time; sometimes the *minute*, and at other times the *second*. On this account the unit adopted is always mentioned in connection with the velocity. For example, we speak of the speed of a railway train as forty miles *an hour;* the piston speed of an engine as five hundred feet *a minute;* the cutting speed of a planer as sixteen feet *a minute;* the velocity of light as 192,000 miles *a second*, etc. If there was only one unit in use (the minute, for example,) we would not have to mention it with the velocity. We would simply say the speed of the train is two-thirds of a mile; the velocity of light is 11,520,000 miles, etc,. the unit of time being understood to be the minute. In scientific investigations the second is generally used as the unit of time, while the hour and the minute are generally adopted in ordinary practice. In these papers we will adopt the minute as the unit of time, except when otherwise stated.

* About the most meaningless definition of velocity in print is that given in a book which bears no author's name. This is the definition: "Linear velocity is the number of inches or feet a point moves along a line in a given time." According to this definition, the train which traveled 200 miles in *four hours* (the "given time") had a velocity of 1,056,000 feet, and the stage coach which traveled the same distance in *twenty-five hours* (the "given time") had the same velocity—1,056,000 feet!

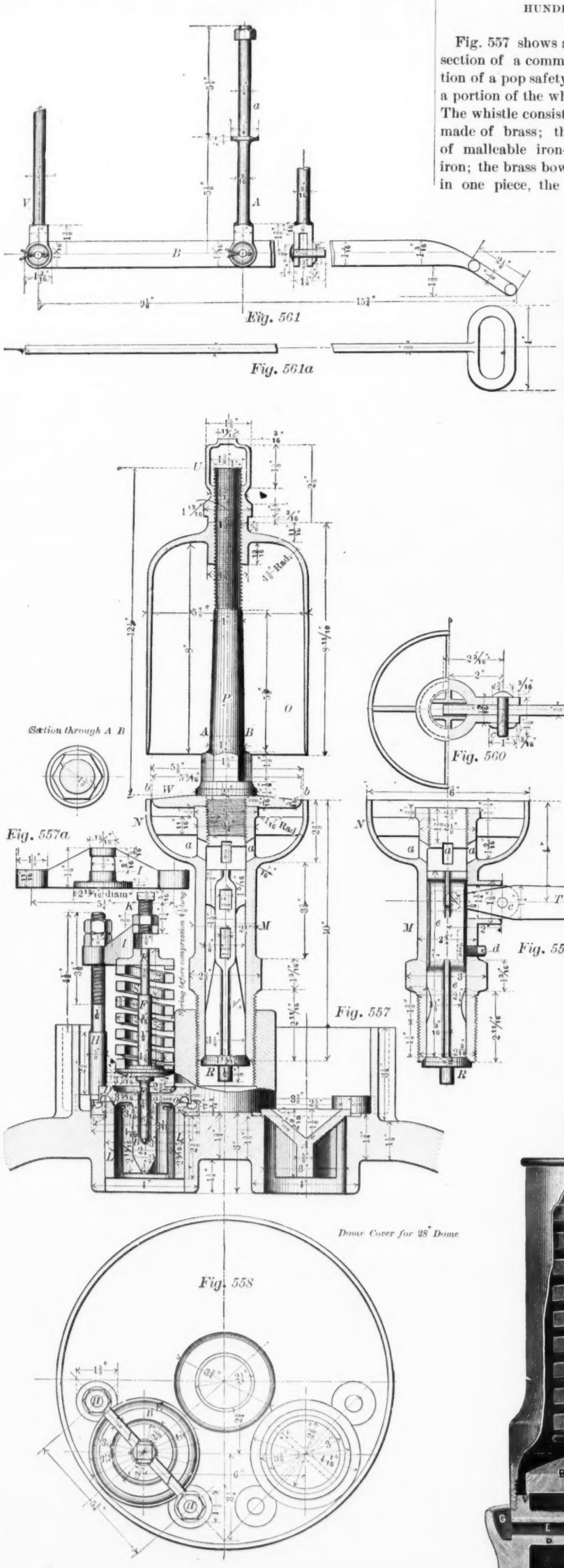


Fig. 557a. Fig. 557. Fig. 558.

Modern Locomotive Construction.

BY J. G. A. MEYER.

HUNDREDTH PAPER.

Fig. 557 shows a section of the whistle, a section of a common safety valve, and a section of a pop safety valve. Another section of a portion of the whistle is shown in Fig. 559. The whistle consists of the bell *O*, generally made of brass; the stem *P*, generally made of malleable iron—sometimes of wrought-iron; the brass bowl *N* and the shank *M* cast in one piece, the brass disk *W*, the brass valve *R*, and the wrought-iron lever *T*. The valve *R* rests against the conical seat formed on the bottom of the shank. The valve is made with guides or wings *e e* extending upwards in the shank for a considerable distance, so as to provide for a bocket for the screw *d*, which prevents the valve from turning, and also, for a bocket which receives the end of the lever *T;* the height at which the lever *T* must be placed above the dome is generally determined by the height of the cab above which the lever *T* must pass. The disk *W* is held in position by the stem *P*, which is screwed into the hub cast in the center of bowl. An annular opening *b b* is left between the disk *W* and the inner surface of the bowl. The upper end of the bell *O* is tapped, and can be set to any desired height on the stem *P*, and secured in its position by the jam nut *U*. The outer diameter of the bell must, of course, always be a little larger than the outer diameter of the annular opening *b b*. The lever *T* works on the fulcrum *c*, and it must move the valve *R* downwards when a communication with the steam space in the boiler is to be opened, enabling the steam to flow upwards in the shank, then pass through openings *a a*, and finally flow out through the annular opening *b b*, and striking the lower end of the bell *O*, thereby producing either a deep or shrill sound, according to the size and proportions of the whistle.

Fig. 562.

Fig. 560. Fig. 559.

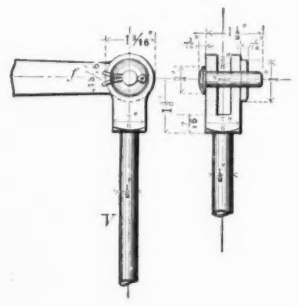


Fig. 561a.

Fig. 563.

Fig. 560 represents part of the plan of the bowl, and a section through the valve and fulcrum *c*. The size of whistle is designated by the outer diameter of the bell; the whistle here given is called a 6-inch whistle, and this size is the most common one, used on nearly all locomotives; sometimes a 4-inch whistle is adopted for small locomotives running on ordinary surface roads.

Fig. 561 represents another whistle lever, *B*, which is placed in the cab. The rod marked *V* in Figs. 561 and 559 represents one and the same rod, which passes through the roof of the cab and connects the lever *B* to the lever *T* (Fig. 559). The lever *B* works on the fulcrum *A*, whose shank *a* passes through the roof of the cab and is fastened there. A plan of the lever *B* is shown in Fig. 561*a*. This arrangement of whistle is often, but not exclusively used; indeed, sometimes the whistle is operated simply by a cord.

Fig. 562 represents a single bell chime whistle;* the peculiar features of this whistle are found in the construction of the bell, which is divided into three compartments. One of these compartments extends throughout the whole length of the bell; the second compartment is made somewhat shorter, and the third still shorter. The whistle valve need not differ in construction from that of any other whistle, and can be made to suit the taste and experience of the designer. This whistle produces three distinct tones, which harmonize and give an agreeable musical chord; and when they are used on passenger trains exclusively, serve to distinguish the latter from freight trains. These whistles have been adopted for passenger service on several railroads, and are favorably endorsed.

In Fig. 557 the section *A* is that of a common safety valve, which has been illustrated in Fig. 551. *B* is a section of a pop safety valve, first introduced on locomotives by Geo. W. Richardson. The openings in the dome top for both safety valves are generally 3 inches diameter, but for the pop valve the opening is reduced by the brass bushing *L*, making the opening for the safety valve $2\frac{1}{4}$ inches diameter, which is the size of all locomotive pop safety valves. The brass bushing *L* is pressed tightly into the dome top. On the top of this bushing a conical valve seat *C* is formed, on which the valve *B* rests. The valve is made with wings or guides extending nearly to the bottom of the bushing.

* Patented and made by the Crosby Steam Gauge and Valve Co., of Boston.

In the center of the valve a hole of considerable depth is drilled, and on the bottom of this hole a spindle *F* rests, which fits very loosely in the hole. The disk *G*, which is pressed on the spindle, supports the spring *S;* the upper end of this spring acts against a disk cast to the cross-bar *I*, usually made of brass. On account of showing the valve in section, one-half of the cross-bar is cut off, and the remaining half is shown foreshortened. A full view of the cross-bar is given in Fig 567*a*. The upper end of the spindle *F* is guided by the cross-bar. Two wrought-iron studs, *H H*, are screwed into the dome top; one of these only is shown in Fig. 567. The nuts on these studs regulate the height at which the cross-bar is to be placed above the valve, and thereby regulating the resistance of the spring. The set-screw *K* is for the purpose of preventing the valve from lifting too high.

When common safety valves are held down by springs arranged as shown in Fig. 552, or as in Fig. 557, a difficulty presents itself, namely, that the resistance of the spring increases with the lift, and therefore the lift will be insufficient, and will not be as great as that of a safety valve held down by an ordinary weight; even with the latter arrangement, the lift of the valve in many cases is less than desired. The pop valve is designed to overcome this difficulty, and therefore the diameter of the upper end of the valve *B* is made considerably greater than the diameter of the opening, and a groove is turned in the lower face of this enlarged end of the valve; another groove *E* is turned in the upper face of the bushing, both grooves being outside of the valve seat. Now as the valve lifts, these grooves fill with steam, causing it to act with considerable energy on increased surfaces of the valve and seat, enabling it to overcome to some extent the increased resistance of the springs, and giving it a lift which will increase the venting capacity of the pop valve to more than double that of the ordinary safety valve loaded with a weight.

Many of these valves are used without a casing; in others, the spring is encased so as to reduce the noise of the escaping steam.

Fig. 563 represents a Crosby pop safety valve. In this design the valve *B* rests upon two flat annular seats *V V* and *W W*, which lie in the same plane, and form a part of the shell *A A*. This shell may be said to consist of two distinct parts; namely, the inner cylindrical chamber *C C*, and the outer cylinder *A A;* these two are connected by the hollow arms *D D* radiating horizontally, allowing the steam to pass between the arms and act against that portion of the lower surface of the valve *B*, which is exposed between the annular valve seats. The valve *B* is made with wings or guides *X X*, which project into cylindrical chamber *C*. When the valve is raised against the resistance of the spring *S*, the steam flows over the inner annular valve seat *W*, passes into the cylindrical chamber *C*, and out through the passages *E E* formed in the arms *D D*. The flange *G G* is for the purpose of turning the current of steam upwards. The tension of the spring *S* is regulated by the screw bolt *L*. The casing around the spring serves for a frame against which the end of the spring acts, and also reduces the noise of the escaping steam In this valve also, provisions have been made to overcome the increasing resistance of the spring when the valve is raised off its seat, for we have already seen that when the valve is closed, the steam acts on that portion of the lower surface of the valve, which is confined within the annular valve seats *V* and *W;* and now, when the valve is raised off its seat, the whole lower surface of the valve is exposed to the action of the steam.

The pressure which the spring *S* in this valve has to resist will be equal to the area of the lower surface of the valve, which is confined within the outer edge of the annular valve seat *W*, and the inner edge of the annular valve seat *V*, multiplied by the steam pressure per square inch.

In the Richardson safety valve, the pressure which the spring has to resist will be equal to the area of the safety valve opening, multiplied by the steam pressure per square inch.

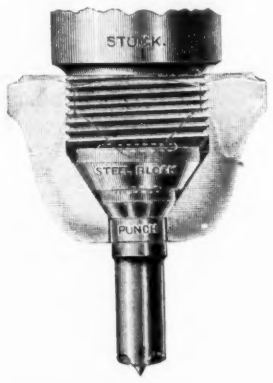
Reducing Coupling for Spiral Punches.

Some time since we noticed the fact that The Pratt & Whitney Co., of Hartford, Conn., had taken in hand the manufacture of the spiral punches formerly made by the De Lamater Iron Works of this city.

These punches have now been adopted by the leading makers of punching machines all over the country, who make their machines to receive them.

We illustrate on this page a device calculated to add to the convenience of the tools, and to effect a saving of time in using them.

It is known as a reducing coupling, and its use enables punches of various sizes to be used with the same stock, and still maintain



the same length from the end of the stock to the end of the punch in every case. What is here meant by the stock is the part so designated in the cut, and is the shank, the lower end of which is threaded to receive various nuts or couplings, the inside beveled surfaces of which engage with the beveled shoulder on the punches. By the use of steel blocks of various thicknesses, the height of the punches is kept uniform, and punches of small diameter and short lengths can be used on stocks made for larger punches, and the necessity for changing stocks is avoided.

A few days ago we saw a boiler that is worth more than passing mention. It belongs, now, to a saw mill; but as it is placed outside the mill, and blocked up in position by logs and bits of wood, the appearances indicate that the proprietor has some misgivings as to the length of time that his boiler is going to stay with him.

Running from the dome to the mill is a steam pipe, jacketed only by the accumulated rust of several winters. The pipe not being long enough for one length to reach from the boiler to the mill, there is a joint in it; and that joint is a study. One of the lengths of pipe is a little larger than the other, so that a sort of telescope joint is formed, the packing for which is composed of chips driven in tightly all around. Of course the leakage of steam at this joint is almost as great as the flow through the pipe itself.

There was neither safety valve nor pressure gauge attached to this wonderful boiler; and we looked for a glass water gauge in vain, though we did find two try-cocks in a somewhat dilapidated condition. Some day or other—probably not very far away in the future—this boiler will rebel, and another "mysterious explosion" will go on record.—*The Locomotive.*

Among the various uses of celluloid, it would appear to be a suitable sheathing for ships, in place of copper. A French company now undertakes to supply the substance for this at 9 francs per surface meter, and per millimeter of thickness. In experiments by M. Butaine, plates of celluloid applied to various vessels in January last were removed five or six months after, and found intact and free from marine vegetation, which was abundant on parts uncovered.—*Engineering.*

According to the recent report on railway accidents issued by the London Board of Trade, the proportion of passengers killed during last year was one in every 6,942,000 carried, and the injured was one in 527,000. Such a record may justly be considered remarkable.

Notes on Superheated Steam.

BY RICHARD H. BUEL.

II.

The accompanying table gives the necessary data for superheated steam at the temperature of gaseity, for pressures varying by intervals of 10 pounds; and for intermediate pressures, interpolations will give the data with sufficient accuracy.

If the superheating is carried above the temperature of gaseity, the necessary data can be calculated by the aid of the preceding rules. The following example illustrates the use of the table and the foregoing rules:

Steam is to be superheated to a temperature of 500°, under a constant pressure of 105 pounds per square inch. What will be its volume and weight, and how many British thermal units will be required to change a pound of saturated steam at the given pressure, into gaseous steam at 500°?

By the accompanying table, the temperature of gaseity is

$$423.9° + \frac{432.5° - 423.9°}{2} = 428.3°.$$

The superheating above the temperature of gaseity is

$$500° - 428.3 = 71.7°.$$

The volume at the temperature of gaseity is

$$4.956 - \frac{4.956 - 4.539}{2} = 4.747 \text{ cu. ft. per lb.}$$

The volume at 500° is

$$4.747 + 4.747 \times \frac{71.7}{493.2} = 5.437 \text{ cu. ft. per lb.}$$

The weight at 500° is

$$\frac{1}{5.437} = 0.18393 \text{ lb. per cu. ft.}$$

The amount of heat required to change a pound of saturated steam into gaseous steam is

$$50\ 4 + \frac{51.7 - 50.4}{2} = 51.1 \text{ B. T. U.}$$

The amount of heat required to change a pound of saturated steam into gaseous steam at 500° is

$$51.1 + 0.475 \times 71.7 = 85.2 \text{ B. T. U.}$$

The principles and rules relating to saturated steam, as given above, are based upon the most trustworthy data accessible to the writer. The statements made in different articles on this subject vary so greatly that the selection of the most reliable authority is difficult; and it seems proper to notify the reader that the data here presented, while giving probably a close approximation to the actual conditions, may be somewhat changed by more extended experiments on superheated steam.

PROPERTIES OF SUPERHEATED OR GASEOUS STEAM, SUPERHEATED AT CONSTANT PRESSURE TO THE TEMPERATURE OF GASEITY.

Absolute pressure, pounds per square inch.	Temperature, Fahrenheit.			British Thermal Units above 32° Fahrenheit, per pound.			Volume, cubic feet per pound.		Weight, pounds per cubic foot.		Absolute pressure, pounds per square inch.
	Of Saturation.	Of Gaseity.	Superheat.	Saturated Steam.	Gaseous Steam.	For Superheat.	Saturated Steam.	Gaseous Steam.	Saturated Steam.	Gaseous Steam.	
P	T	N	T-N	H.	R	H-R	C	m	W	h	P
1	2	3	4	5	6	7	8	9	10	11	12
15	212 0°	284 3°	72 2°	1146 6	1177.5	30 9	26.37	28 91	.03793	.03459	15
20	227 2°	302.3°	75 1°	1151.2	1184 7	33 5	20.02	22.10	.04995	.04525	20
30	249.8°	329 6°	79 8°	1158 1	1195 4	37 3	13.62	15.14	.07344	.06221	30
40	266 5°	349.8°	83.3°	1163.3	1203.4	40 1	10 36	11 58	.09653	.08638	40
50	280 6°	366 9°	86.3°	1167.4	1210 1	42 7	8 389	9.414	.11920	.10623	50
60	292 1°	380.9°	88.8°	1170 9	1215.5	44.6	7.056	7 947	.14165	.12584	60
70	302 5°	393.5°	91.0°	1174 3	1220.5	46 2	6.102	6.890	.16388	.14513	70
80	311.6°	404.6°	93.0°	1177.2	1224 8	47.6	5.378	6.090	18593	16421	80
90	319 8°	414.6°	94..°	1179 7	1228 7	49.0	4.811	5 461	.20784	.18311	90
100	327 4°	423.9°	96.5°	1181 9	1232.3	50.4	4.355	4 956	.22960	.20179	100
110	334 4°	432.5°	98.1°	1183 9	1235 6	51 7	3.979	4 539	.25130	.22031	110
120	340 8°	440 3°	99.5°	1185.9	1238.7	52.8	3.665	4.189	.27287	.23874	120
130	346.9°	447 8°	100.9°	1187.8	1241.6	53 8	3.398	3.892	.29431	.25697	130
140	352 5°	454.7°	102 2°	1189.4	1244.2	54 8	3 168	3 635	.31571	.27512	140
150	358.0°	461.4°	103.4°	1191.1	1246 8	55.7	2 967	3 412	.33701	.29310	150
160	363 2°	467.8°	104.6°	1192.7	1249.3	56 6	2 792	3 216	.35822	.31095	160
170	368 1°	473.8°	105 7°	1194 2	1251.6	57.4	2.636	3 042	.37941	.32874	170
180	372 8°	479.5°	106.7°	1195.6	1253.9	58.3	2.497	2 887	.40053	.34643	180
190	377 2°	484.9°	107 7°	1197 0	1256 0	59.0	2.372	2.747	.42163	.36406	190
200	381.4°	490.1°	108.7°	1198 3	1258.0	59.7	2 259	2 621	.44264	.38160	200
210	385.7°	495.4°	109 7°	1199.6	1260.0	60.4	2.157	2.507	.46364	.39891	210
220	389 7°	500.3°	110.6°	1200 8	1261.9	61 1	2 064	2 402	.48456	.41624	220
230	393 5°	505 0°	111 5°	1201 9	1263.7	61.8	1.978	2 307	.50546	.43351	230
240	397.3°	509.6°	112.3°	1203.1	1265.5	62 4	1 900	2 219	.52635	.45067	240
250	400.9°	514 0°	113.1°	1204.2	1267.2	63 0	1 828	2.138	.54717	.46780	250

The formulas corresponding to the preceding rules will be found below, for the convenience of engineers who prefer to use analytical expressions.

Heat of evaporation above 32° Fahrenheit, in British thermal units, of steam superheated at absolute pressure P, in pounds per square inch:

(*D*), superheated to a temperature (*B*) between the temperatures of saturation and gaseity,

$$D = 1{,}075 + 0.4805 \times [B - 32 - 20.403 \times (P)^{1/3}].$$

(*R*), superheated to the temperature (*N*) of gaseity, *T* being the temperature Fahrenheit of saturated steam corresponding to the pressure *P*,

$$R = 1{,}092 + 0.475 \times (T - 32).$$

(*X*), superheated to a temperature (*O*) above the temperature (*N*) of gaseity, *R* being the total heat of steam superheated to the temperature *N*,

$$X = R + 0.475 \times (O - N)$$

Temperature (N) of gaseity, of steam superheated at pressure P, T being the temperature of saturated steam at the pressure P:

$$N = T + 32 + 20.403 \times (P)^{1/3}.$$

Volume, in cubic feet per pound, of steam superheated at any absolute pressure (P), in pounds per square inch:

(*k*), at any temperature (*B*) between the temperature of saturation and gaseity,

$$k = \frac{0.644 \times (B + 461.2) - 23.542 \times (P)^{1/3}}{P}.$$

(*m*), at temperature (*N*) of gaseity,

$$m = \frac{0.644 \times (N + 461.2) - 23.542 \times (P)^{1/3}}{P}.$$

(*n*), at any temperature (*O*) above the temperature of gaseity (*N*), *m* being the volume at the temperature *N*,

$$n = m + m \times \frac{O - N}{493.2}.$$

The Practical Engineer, an English contemporary, in noticing the steam engine exhibits at the Paris Exposition, after paying a compliment to the Straight Line engine on exhibit, true to some sort of instinct, proceeds to condemn it as not up to English practice in that the piston has no packing rings. It says: "The piston is simply a long hollow block turned to fit the cylinder very accurately . . . but we do not think the economy, after working for a time, can be equal to our own engines. Cylinders and pistons are sure to wear, in time, however well made."

This criticism is not only charging a windmill, but it is setting up the windmill for the purpose of charging it. As a matter of fact, the Straight Line engine that our contemporary criticises has packing in its piston—a fact that might very easily have been ascertained by inquiry.

Dr. Hopkinson has recently examined the magnetic properties of a new alloy manufactured by the Steel Company of Scotland, which contains 20 per cent. of nickel and .085 per cent. of manganese. He finds that it is almost non-magnetic, its permeability being only 1.4, or sensibly the same as that of manganese steel.

Scrap-book Reflections.

BY W. S. ROGERS.

I was in a shop the other day where lathes are built, talking with the proprietor. One of the men rushed to the vise, clamped a nicely-polished wheel in it without looking to see that there were no coppers in the jaws, and as he enlarged the hole in the center with a half-round file, the proprietor encouraged him by saying, "Hurry up, Charley." I also noticed that Charley afterwards spent half an hour with emery cloth and scraper improving the blemish on that wheel.

Of course this builder does not get a very high price for his tools, nor does he pay very high wages, but I can't help believing that he could sell more stuff, get more for it, and have it called better stuff, if he used his men as thinking mechanics instead of trying to use them as reasonless automatics.

The owner of a shop once told me that he would be perfectly satisfied if he could make his men go from one part of the shop to another on a run. "They walk about as if they were thinking of something important. I can't make them understand that I do the thinking and they are to do the work," said he. Well, one day he was coming up-stairs and met one of the hands going down on a run; they both went to the bottom together, and when the old man gathered himself up, he was the most "perfectly satisfied" man I ever saw.

I once asked a draftsman who sat at his board every night until ten o'clock, how he could stand it, and what he did. He answered, "I think, and I must be paid for it." Now, I have noticed that engineers who have won fame and dollars for work they have performed did not require a gas-jet, paper, pencil and drawing board in front of them in order to do their thinking, but got as far away from the work on hand as possible, and took the problem to be solved with them. The mind of the true engineer is one constant stream of thought, reaching out for each and every known mechanical movement that may assist in accomplishing the end desired, and he that is able to dam his thoughts at will like the waters of a brook, goes to the bottom eventually, or costs his friends lots of money to carry him on top. Then, the idea of needing a drawing room and a whole kit of tools in order to "think" looks funny. The work of putting his thoughts in tangible shape to produce required results is what I always supposed an intelligent engineer was expecting pay for.

I worked for a man once, who outgrew the old shop and built a new one, and when we moved into it the employes hardly realized the change, and the neighbors were somewhat surprised, so quietly and systematically was everything performed; and in after years, when the opportunity came to me to move a plant, I tried to equal him. Recently I saw the United States move a carpenter's shop. Three hours after they began, the place was a cross between chaos and hades, and the entire force of workmen were demoralized for ten days afterward. I am glad I learned the other way first.

I had occasion once to promote a jour. to foreman. Within a week the head of the firm informed me that I had made a very foolish choice in selecting that man. "Why, I've watched that fellow for two hours out in the shop, and he hasn't done a bit of work, but just stood around with his white shirt and collar. Our old foreman used to do lots of work," said he, but he had failed to notice, also, that the old foreman kept the hands waiting, while the fellow with the white shirt always had plenty of working material ahead of the men.

Reading in "Shop Notes" about the Pratt & Whitney Co. and their employes regarding night work, takes me back a good many pages in my note book, to a shop where night work was tried, and a record kept of it both in the office and by the foreman. Here is the office record: "First two weeks, very satisfactory. Third and fourth weeks, not so well, but will do. Fifth and sixth weeks, losing money. Seventh week, dead loss." The foreman's diary reads thus: "First week, boys enjoy it; second week, boys getting uneasy; third week, boys coming in late and getting stiff in the joints; fourth and fifth weeks, have to growl at all hands for general slackness; three men gone elsewhere; sixth week, boys pull themselves in at 7 A. M. and wish it was 10 P. M.; three more men left; seventh week, nothing but sheer brute force prevents mutiny in the shop and gets things half way right."

Now, there was no elaborate theory spun out as to why this was, nor any efforts made to discover any "if" to alter the case. 'Twas a very plain, homely sort of an experiment, from which I have concluded that there is no money in night or over-time work for the boss, no satisfaction to the man who is trying to make a useful citizen of himself, and should never be indulged in, except to get out of a very deep hole, and then for as short a time as possible. A superintendent who values his reputation for good results and economy always fights shy of over-time.

A Testing Machine.

BY ROBERT E. MASTERS.

Several years ago the writer illustrated in the AMERICAN MACHINIST, a number of machines of different styles for testing the strength of cast-iron, and in March, 1886, called attention to the difference in the shrinkage of a variety of mixtures. Foundrymen are realizing more every day the value of this important branch of foundry practice, and a large number of foundrymen are anxious to know the results of the mixtures they are using, but do not feel able to buy an expensive machine for testing. The cut shows a very simple and accurate machine designed by myself during the past winter, and presented here to the foundry trade for testing the transverse breaking strength, shrinkage and deflection of cast-iron.

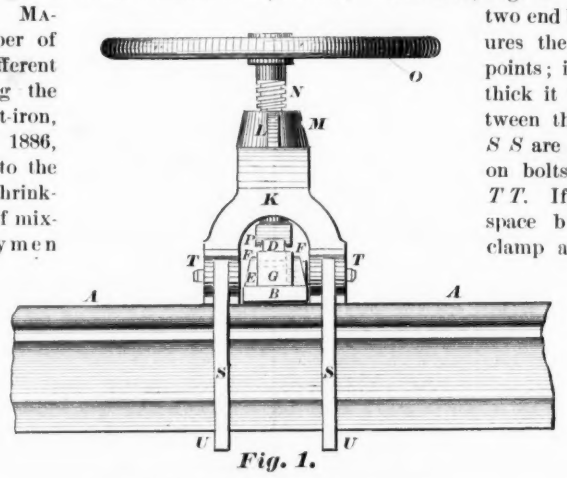


Fig. 1.

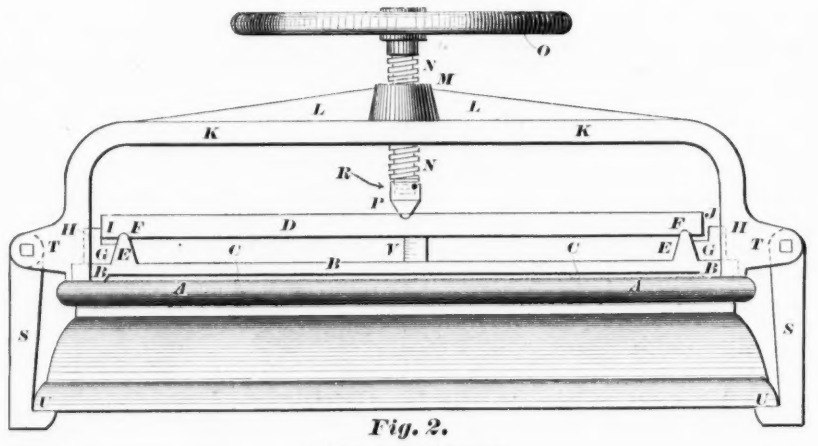


Fig. 2.

A TESTING MACHINE.

Nearly every foundry has a pair of scales on wheels, to which this can be attached. Figs. 1 and 2 are end and side elevations, the wheels, upright and weighing-beam of the scales being omitted. *A A* is the scale platform, and *B B* is a ½" x 3" plate 1" thick at the ends. This plate is to support the test bar. It will be seen that it rests on the iron rim or frame of the scales at *B*, and is clear of the wooden platform *C C*; this gives a level bearing.

D D, Figs. 1 and 2, is the test bar in position, resting on the points of bearing *E*. The tops of these bearings are rounded, and are 24" from center to center, there are projections 1" (full) apart, and planed at the sides for the bar to rest between, as at *F*. *G G* are lugs cast on the plate back of the bearing to determine the shrinkage. These lugs are planed across on the inside at *H* to exactly 26" apart. The test bar pattern is made 26" long by 1" square measured by the *common* rule and moulded carefully, and drawn without rapping endwise. The bar when put in to test is placed against the lug at *I*, and the space *J* between the other end of the bar and lug is the shrinkage. *K* is the bridge or arch, the legs of which rest on the frame of the scales, on each side of the plate *B*. *L* is strengthening strip, and *M* the hub or boss for the screw *N*.

This screw has a square head for hand-wheel *O*. If there is no hand-wheel pattern large enough, it is not necessary to make one. A hole can be drilled in the head of the screw and a wrought bar put through it, or have a square forged on the end of a rod to fit over the head. *P P* shows both views of center bearing. It is a cast-iron swivel on the end of screw. When the pressure is put on, the screw revolves in the swivel, and it cannot drop off when not in use, being held by a pin through the swivel which is cleared by the groove in the end of screw shown by dotted lines at the arrow point *R*. This center bearing is rounded where it bears on the bar, and is planed on the sides of the projection, so that it fits snug over the sides of the bar, as seen at *D*, Fig. 2. This with the two end bearings measures the bar at three points; if it is over 1" thick it will not go between the projections. *S S* are clamps swung on bolts between lugs *T T*. If there is a little space between the clamp and bottom of the scales at *U*, a thin wrought-iron wedge can be put in tight enough with the fingers—don't drive it.

V is a piece of steel rule fitted in the plate to tell the deflection; this can be done by watching the bar when breaking it. The points of bearing *E* ought to be exactly 24" apart, no matter what width the scales are. For instance, if the scales are 20" wide, the plate *B* and bearings *E* can extend over the side of the scales, between the legs of the arch. Again, if the scales are 36" wide, the plate *B* can be long enough to rest on the iron frame of the scales and the 24" still be maintained.

When ready to break the bar, take the weight of the machine, bar and all, then put the pressure on steadily, and add the weight gradually, until the bar is broken, deduct the weight of machine (first taken) from the figure at which the break occurred, and the resistance of the bar is obtained.

I have cast several pairs of bars (two at once) at different heats, and then from each pair, sent one (marked) away to a high-priced machine, and there was only the variation from the figures I obtained on the bars saved to test on the machine shown, usual to bars poured at once from the same ladle.

Any foundryman who wishes to use a machine of this kind will have to make it to suit the scales he has. The patterns are plain, and easily made, and the thread on the screw and in the boss can be cut, eight to the inch, on a bolt and nut machine. The machine weighs about 75 pounds, is easy to handle, and ought not to cost over five dollars.

Exposition Notes.

(Correspondence.)

The editorial correspondence appearing in the AMERICAN MACHINIST during the past few weeks has a peculiarity which is commented on in England very favorably. Its peculiarity consists in its being the first account which has appeared in an American journal which is truthful from the very commencement, and which, therefore, not only makes fair claims for American superiority—where such exists—but also allows credit for superiority in English and Continental productions over anything American where such exists. Travelers as a rule blindly refuse to see any merit whatever outside their own country. None are worse in this respect than Englishmen and Americans. On this side we have long since become aware that the mechanical engineering of the continental nations was very much better than it was 20 years ago; but until you appeared with your Exposition Notes no American journal has admitted that outside America was any good thing.

Specially I would draw the attention of some of the readers of the AMERICAN MACHINIST to your remarks of Aug. 15th issue anent toothed wheels. After making a very fair claim for the special excellence of the wood-working machinery of Messrs. J. A. Fay & Co., you speak of the teeth of certain cast gears being good enough to be called perfect.

Now some time ago in your columns I pronounced favorably for cast gears as against cut gears, and gave reasons for my preference. For this I was taken to task by some of your readers, and am afraid that for adhering to my statement I not only did not convince my opponents, but was set down by them merely as an ignorant fellow who knew nothing at all about gears anyhow. As, however, I do claim to some experience in this line, your own remarks on gears as seen at Paris were welcome reading, so remarkably do they bear out my statements that gears can be cast from good patterns which are better than any cut gears. To such cast gears I have always been accustomed, and now you can add your own testimony to the veracity of my claim, it may give rise to the production with you of better cast gears than have hitherto been thought possible.

The reason for cut gears in America is to my mind simply an outcome of the idea that they cannot be cast, and the assertion that they *are* cast, and truly cast in Europe, is not accepted simply because it is the fashion to believe nothing possible which is not American practice. True to the old Anglo-Saxon spirit of stubbornness, Americans are very like what we have been ourselves—very incredulous of the powers of any foreigner.

Some years ago an English smith who had been in Belgium was descanting on the ways of the Belgians to his old employers in England. After running through a string of their shortcomings he concluded with an emphatic statement of fact as follows: "And the fools, they call a hammer—marteau." To call a hammer anything but a hammer was clearly a breach of sound sense, which this smith could not forgive, and there is much of his spirit yet alive.

You have drawn pointed attention to the super-excellence of some of the Continental castings. Not only you, but every one must acknowledge that the Belgians are especially good as moulders, the three cylinders shown by the Societe Cockerill, of Seraing, being most remarkable. This is not the first time I have seen specially good work turned out by this same foundry—work in which every detail of the pattern has come out faithfully reproduced, without being slurred over by the trowel. A good pattern in the hands of a good moulder should leave the sand perfect, and this is a *sine qua non* in regard to toothed

wheels. If a tooth breaks down in the mould the moulder who will patch it up well is not often there, and though an engine frame can be smoothed up, it never looks so well as the untouched mould. The best Belgian castings do not seem to have been touched after moulding, but to have been simply dusted and poured right off. The sand of a foundry is an absolutely homogeneous mixture, or can be made so, over any desired area by sufficient mixture, and given a moulder of fair skill and experience there appears no good reason to doubt the possibility of producing perfect castings from good, smooth, varnished patterns. There are of course certain points to be observed in respect to contraction allowances, neglect of which may cause uneven contraction; but in such an article as a gear wheel the proper proportioning of the rim to the arms and hub, and to the roots of the teeth, is known, and an accurate pattern should be answered by an accurate casting, and good patterns in a skillful moulder's hands will not be rapped for draft with the same force and freedom that is bestowed by the unskilled man who has not risen beyond the ability to mould sash weights or even the weights for a large moulding box.

Speaking of castings generally, it seems to me that too little attention is placed to the disposition of gates and risers. In pouring a mould, as of a wheel, the danger chiefly to be feared is washing off of the corners of the sand teeth, and it always does puzzle me to account for teeth of sand not breaking down; but it does seem that in a large wheel there should be more runners than are sometimes found. Too few runners seem to point to the probability of the portions of the casting between two runners being very much cooler at the time pouring is finished than the parts just below the runner which are first heated up by the flow of metal past them and then filled up by hot metal, the other portions of the mould simply being filled by metal which has flowed through the cold mould. Is this a cause of the slight ellipticity sometimes observed in wheels and pulleys?

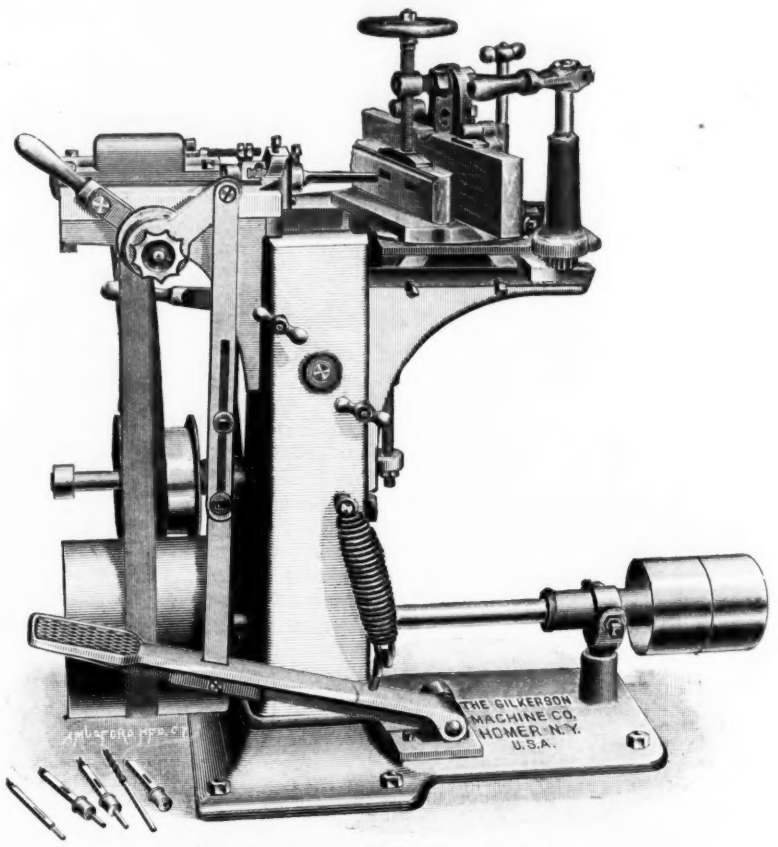
You have drawn attention to the fearful and wonderful complication which exists in the valve gears of certain Continental locomotives. In spite of such complication I cannot hear that their coal consumption is less than that of English locomotives, though these have the simple link motion. At the same time there is a locomotive at Paris for the Chemin de Fer de l'Ouest, which is as simple in construction as any English engine, and proves at least that the complexity of gear may soon die away and Continental locomotives become perhaps as good in design as some of the stationary engines—notably the Machine Sulzer. It is worthy of remark, too, that a very business looking locomotive hailed from Italy, and it is not a little strange that some of the least simple and most ungainly were Belgian productions.

The Crampton patent locomotive deserves mention. It is to be seen in the building occupied by Cail et Cie. This locomotive, built on the lines of the late Mr. Crampton's patent for the Northern of France Railway, has been continuously at work very many years with satisfaction. A similar engine was the Liverpool, which was exhibited at the original Crystal Palace in Hyde Park in 1851. The Liverpool had 18 x 24 inch cylinders, and one pair of 8-feet drivers placed behind the fire-box after the manner as once described of a stern wheel boat. It is said she was taken off the line—the Northwestern of England—owing to being too heavy for the rails, for I believe the driving pair were loaded to 18 tons (2,240 lbs.) a big load for the iron rails of 40 years ago nearly. Quite a little while before his death I remember to have seen somewhere a letter of Crampton's upholding his system as the best to-day, and when engines of his patent have run so long in France it seems almost a pity that their trial elsewhere should have failed merely from track weakness which does not now exist. But this is the case with many things that possess merit as well as with locomotives; they are condemned by their surroundings. W. H. BOOTH.

An Old Engineer.

There walked into the office Wednesday afternoon a man whose name is associated with one of the greatest landmarks of civilization. He is known as Capt. Jack Lawson, and when George Stephenson's "Rocket" won the prize in the great locomotive competition on the Liverpool & Manchester Railway, beating the "Sanspariel," and the late Mr. Ericsson's "Novelty," he stood on the winning engine's footboard. Not only that, but when the first locomotive brought from England came over for the Baltimore & Susquehanna road in 1831, Mr. Lawson came over with her, and ran her on the twelve miles which were all the completed portion of that road. From Baltimore to Green Springs was the run, and Mr. Winchester was president of the road.

A year later, Mr. Lawson ran a new engine on the road built from Tuscumbia to Decatur, Ala., in order to get round the Mussel Shoals of the Tennessee River. This engine, like the "Harold," used on the Baltimore road, was built by the Stephensons, and had four wheels, the drivers being connected outside. The cowcatcher and trucks were put on after she got to America, and Mr. Lawson claims, the first pair of trucks ever put under any locomotive were those he put under the old "Harold." As for the road, it had strap rails on stringers, and was a decidedly primitive affair. After some time in Alabama, Mr. Lawson took to the river. He has been engineer on nearly every well-known floating palace of the West, his career as steamboat engineer beginning with the old "Brighton," and extending over fifty years.



HOLLOW CHISEL MORTISING MACHINE.

He is now 81 years old, and his wife is 74. They have been married 57 years. Capt. Lawson lives in Paducah, Ky.—St. Louis *Globe-Democrat*.

Hollow Chisel Mortising Machine.

A hollow chisel mortising machine, made especially for wagon and carriage builders, and adapted to all similar work, is shown by the accompanying engraving. The machine lays off its own work, making it interchangeable, and does the work in about the time usually consumed in laying off by the usual methods. All adjustments are made by the operator without changing his position, the base of the machine taking up only 19" x 30" floor space. The operator standing in front of the machine secures the work to the table by means of the clamp screw, and, having the various stops properly adjusted, forces the chisel into the work by means of the treadle, at the same time governing the cut by means of the lever at his left. The head and table are connected together in such a manner that as one rises the other falls, thus balancing both of them without the addition of otherwise useless weight, and at the same time reducing the movement necessary in making the vertical adjustments, to just half what it would be if only one part moved. Secured to the "back piece" of the table is a piece of hard wood, which allows the bit to come clear through the work without splintering on the back side. All the adjustments are clamped by means of hand set-screws, thus doing away with the use of a wrench for that purpose, and the treadle and levers are adjustable to suit the convenience of the operator, so that the machine is equally convenient for men of various heights. All sliding parts are dovetailed, and provided with means for taking up wear; and all shafts and screws are of steel, the bearings on the spindle being ground true, and fitted with the best babbitt boxes. The chuck which holds the bits is made of steel, and will take shanks of the smallest size up to ¼". The collet which holds the chisel is adjustable vertically to compensate for wear of the spindle boxes by the downward pull of the belt. The tight and loose pulleys on the countershaft are 6½" diameter for a 5" belt, and should make 1,000 revolutions. The machine is made by the Gilkerson Machine Co., Homer, N. Y.

The evening class in mechanical drawing at the rooms of the Brooklyn Young Men's Christian Association will begin its sessions at 8 P. M., October 14. It will be under the instruction of Mr. L. Duvinage, a practical engineer. The sessions will be on Monday and Friday evenings, from 8 to 9.30. The class is intended to furnish lessons in linear drawing, applied to the various branches of constructive art, comprising the use and care of instruments, rudiments of geometrical problems, with practical application to mechanical and architectural details for everyday use.

LETTERS FROM PRACTICAL MEN.

Planing Vs of Lathe Beds.

Editor American Machinist:

If I had a job of planing planer or lathe beds, whether singly or in duplicate, I would be very careful in setting the angles and very careful in moving the saddle, *by measure*, the required distance or distances called for between centers of **V**s. This would give me all parts of the surfaces the right distance apart. The job would go together and be its own template. As for time required, I think I would rather plane four (4) medium length beds without templates than to plane three (3) using templates. To get the measure, either depend on the feed screw (if in good order), giving it a definite number of turns to a stop or index point, or else by making a fine mark on the cross-rail, close to the saddle, and then moving the saddle *from* the mark, using a steel scale, or, better, a nice, fine mark across the edge of a thick straightedge, as the distance required. Of course, except on the rough cut, the tool must not be shifted in the saddle until the corresponding surfaces have both been gone over. It is also necessary to complete all the rough cuts, then all the beveling cuts, whether one or more, then the finishing cuts, each in order, setting the angles over and over, and making new marks on the cross-rail for each of the different operations.

The same method is applicable to **V** work turned in a lathe. The trouble in using templates is that the template only shows when the work is wrong or right, and not how much it is wrong, and that is the very point the workman requires. Hence it becomes a cut-and-try job—more try than cut—which is always very slow on a planer.

If the work is to be duplicated often, the repeated measurements become tedious, and some device is desirable to avoid them.

The enclosed sketch shows one way, and it worked well. *a a* are pedestals fixed in the top of the cross-rail; *b* is a flat, rigid bar, slotted to fit over the pedestals. Attached to the bar by bolts *d d* is a forked casting *C*, which may be moved and fastened in vari-

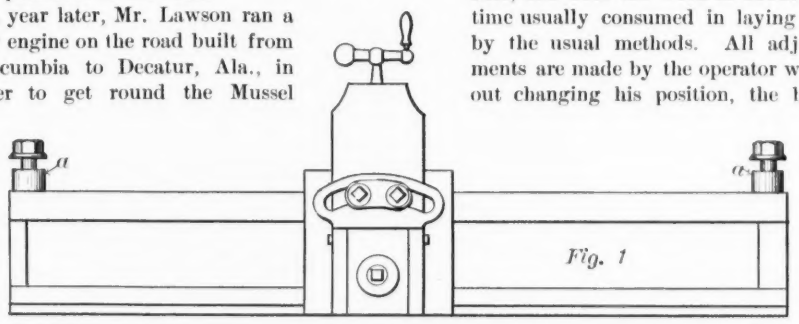


Fig. 1

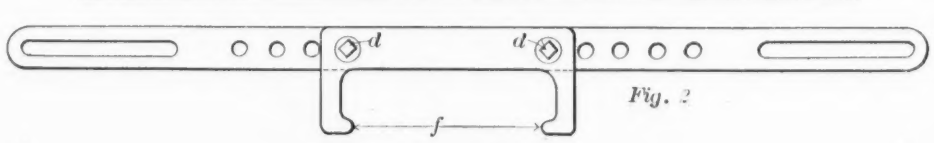


Fig. 2

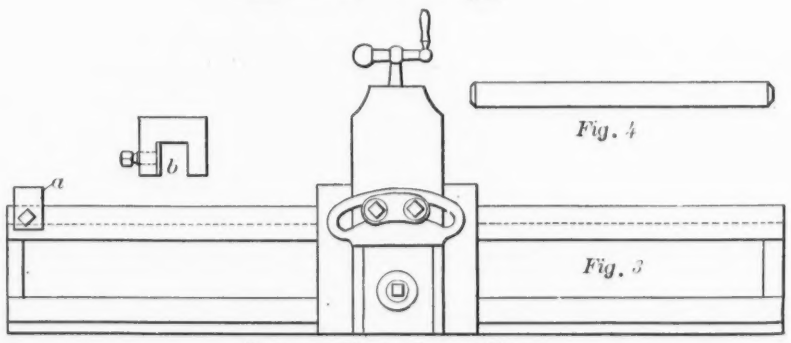


Fig. 4

Fig. 3

PLANING VS OF LATHE BEDS.

ous positions on the bar by means of the various holes. The distance *f*, between points of *c*, equals the distance required for the work, plus width of saddle, which the points embrace.

When saddle is set for the first surface, one point of *c* is put in contact, and pedestal nuts made fast.

For the second surface the saddle is moved over until the other point of *c* is in contact. When the angle is changed the pedestal nuts are loosened, and the bar moved bodily to suit the new position, then made fast, and third surface cut. The saddle then moves over for the fourth surface. This only provides for two Vs, but, by having suitable distance pieces to go between the points and the saddle, any number of Vs can be made. SUPERANNUATED.

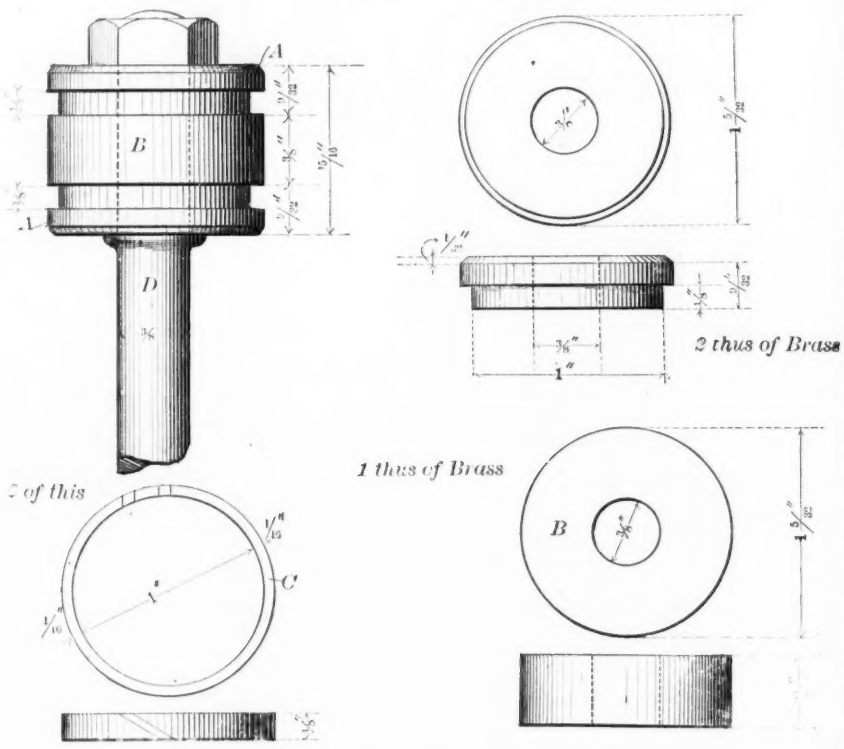
The above was called out by the question and answer No. 317, in which the questioner was advised to make templates for such a job. As the answering of the question referred to fell to my lot, it will be in order for me to explain that I considered the template plan the best for that particular case, because I judged that the questioner only wanted to overhaul an old lathe, and for such a job I think the template preferable. For new work I should not like to depend upon lines drawn upon the cross-rail, even if there was no objection to drawing them there, as I think there is; for nothing looks worse than to see a promiscuous lot of lines drawn about a tool, which, after they are once used, can never be used again, and have no particular significance for any one but the maker of them. The other device shown by "Superannuated" is, I think, a good one, but I once worked in a tool shop where they made use of a plan which is, I think, somewhat more simple, and is capable of giving very accurate results.

It consists simply of a clamp arranged to go onto the top of the cross-rail, as shown at *a*, Fig. 3, an enlarged view of the clamp being shown above at *b*. Then there were a number of ⅝" square bars of steel, like Fig. 4. The ends of these bars were hardened and ground to a good surface parallel with each other, and the length of them equaled the distance between the Vs of the lathe and planer beds which were built there, a set of bars being provided for each different machine.

It is not best, in using this plan, to let the saddle come into contact with the clamp for any of the cuts, and so for an ordinary lathe four bars are required, which, if well made, properly marked, kept in a case by themselves and not abused, will insure almost absolute fits in such work, and, as near as practicable, absolute uniformity. Supposing the planer hand to have a lathe bed on his planer; when he gets ready to plane the Vs he starts a cut down the side of the V nearest him, and then, laying the longest bar on top of the rail with one end against the saddle, he shoves the clamp *a* against the other end and tightens it up. He then takes cuts down the corresponding sides of the remaining Vs, putting in the corresponding bars, and gently bringing the saddle against them each time. It will then be necessary to shift the clamp for the other side of the Vs when the operation is repeated.

In finishing it will not do to adjust the first distance bar and clamp to the saddle after the cut is started, but the saddle should be brought up against the bar by the screw for the first as well as all the other cuts, and it is necessary, of course, to do this very carefully, so as to get the same contact each time. In finishing, the accuracy also depends very much upon the tool holding its edge until the corresponding sides of all the Vs are finished, and usually, in the case of lathes, it is better not to take the Vs in succession as they come, but plane the outside ones first and the inside ones afterwards, because it is more important usually that each pair of Vs should be accurately spaced with reference one to the other than that the outside ones should be accurately spaced with reference to the inside ones.

It is vitally important in using these bars that the surfaces of the cross rail upon which the saddle bears should be made and kept straight and in good order, and if this is done, and means taken to set the head accurately to the proper angle in each case, the best of work can be done with the least bother. The graduations on planer heads are not satisfactory for such work, however, and it is better to make a template of sheet metal to set the head by. This can be simply a thin steel triangle, which can be applied to the head, resting, at the same time, either upon the saddle, or, better, upon the planer bed or parallels placed upon the latter. If then the head be set so that the light is shut



PISTON VALVE FOR WESTINGHOUSE AIR-BRAKE.

out between it and the triangle, much more accurate results are obtained than is usually possible by the graduations; not only because the graduations are usually rather coarse, but because this method also obviates any difficulty which may arise from inaccurate fitting of the swivel to the saddle.

FRED. J. MILLER.

Change in the Piston Valve for Westinghouse Air-Brake.

Editor American Machinist:

Enclosed find sketch of the lower end of the main steam valve of Westinghouse air-pump. A great many of your readers who have the repairing of air-pumps under their control will know of the trouble that is to come when springing the small rings over the head into grooves, possibly breaking two or three rings before two rings are sprung into place. Again, those rings which are sprung into place are generally slightly bent or have a permanent set, and when these piston valves are put into the pump they will blow for some time, causing waste of steam, until rings are worn to bushing. The sketch shows the construction of piston which we use, enabling us to overcome the difficulties mentioned.

D shows piston rod, *B* center of piston, and *A A* follower plates. The piston head, you will notice, is made in three parts, and turned to fit bushings; they are made of brass, and are quickly turned. The manner of replacing the rings is obvious. In this design the rings are round, and, when put in pump, have a much better contact than those which are sprung into the groove, and no broken rings. We have a large number of these heads in use, and they give excellent results. Another advantage this head has over the solid head, is that, when the grooves in the head become worn too wide, the followers *A A* can be closed in to the original width. J. R.

An Adjustable Angle.

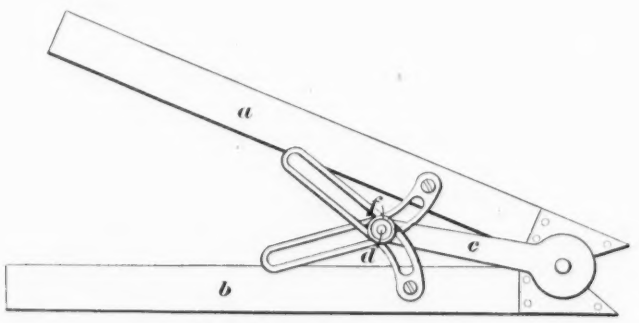
Editor American Machinist:

Here is something that may be of interest to the craft. It is not mine by virtue of invention. I found it with Mr. Parsons, at the Lackawanna Iron & Steel Co.'s. It is an adjustable angle consisting of two legs *a* and *b*, which are hinged at the apex like a nut. To the apex, or hinge, is fixed (by the same rivet that forms the hinge pin) a tongue *c*, in the end of which is fixed solid a stud *d*, with a thread on the end projecting upward, and a thumb nut *f* on it. To each leg is fixed, so that it can swing, a wing *e* and *e'*, having a slot cut in each, as shown. Through these slots the stud projects, and the thumb nut is screwed on so that, when the angle is set, the whole may be clamped together and held rigid.

Under the wings are put washers equal to the thickness of the tongue, under one, and under the other a washer equal to the thickness of the tongue and one wing. This is to make the three parts parallel, so that they will not bind in sliding over each other. The wings are made just long enough to let the angle open 90°.

The object of the tongue is to carry the stud at a fixed distance from the center of the hinge, and the curve in the wings permits the legs to be set at any angle without their projecting over the edge of the legs, and interfering with pen or pencil.

There is no particular curve to be used in the wings, but a hyperbola or a parabola would make it more exact. Neither is there any particular length prescribed for the tongue, to make it work all right. I have made two, one 9" and the other 15" long, and I would not give them for all the triangles I ever saw. GEO. GUNTZ.



AN ADJUSTABLE ANGLE.

John Coffin.

[The following tribute to this gifted young man was written, at our request, by Prof. John E. Sweet, whose intimate acquaintance with him peculiarly fit him for the task. We can fully endorse all that Prof. Sweet has written, not only as to John Coffin's great abilities as an engineer, but as well to his qualities of heart that won the friendship of every one who knew him]:

John Coffin, whose communications have appeared in the AMERICAN MACHINIST from time to time during the last few years, died at Johnstown, Pa., on the 3d of September, at nearly 33 years of age. Born at Chatham, New York, in 1856, he secured a common school education, and the rudiments of the machinists' trade, and went to the Indian Territory with his father, where they were engaged in moving the Pawnee Indians. While there the thought came to young Coffin that he had not all the education that might be useful to him, so, returning, he, after making some preliminary preparations, entered Cornell University. Here, although showing marked mechanical genius and wonderful originality in his geometrical demonstrations, he was dropped from the University roll by the authorities, at the end of the first year, admittedly because of the unfashionableness of his spelling. Leaving the University, he found employment in different machine shops in Ithaca and Syracuse, and in 1880 took the position of foreman in the works of the Straight Line Engine Co.

While in the Indian Territory, and the various machine shops, his genius and mechanical skill helped himself and others out of many a difficulty, and while at the engine works he invented his averaging instrument, now well known to engineers, and designed the throttle valve used on all Straight Line engines. Later he invented a graduating, and other machines used in the manufacture of machinists' scales, by the use of which thousands of these scales have been made, and are now in the hands of machinists, bearing the stamp of Coffin & Leighton.

Some time in 1881 or 1882 he entered the service of the Cambria Iron Works, Johnstown, Pa., where he held the positions of draftsman, foreman, and, later, investigator and inventor. The work which he accomplished there, that was the most valuable and will give him the most lasting name, was that of treating railway axles and rails, by a peculiar way of heating and cooling, which increases their ability tenfold to resist the blows of the drop. The human lives and property this one discovery is destined to save ought to make his name immortal. Another of his practical inventions—that of a new method of annealing and galvanizing fence wire—had just been put in operation at the Gautier branch of the works, when the great disaster blotted it out.

Large works like the Cambria give scope to the inventive genius of any man, however gifted, but, in addition to this, Coffin's work was blended with scientific investigation. Many of his discoveries in the behavior of steel came out of his experiments in the treatment and tempering of the steel hoops for the government cannon, and among other discoveries was that which determined pretty conclusively what takes place when a piece of steel is hardened and when annealed; also that two pieces of clean steel, perfectly fitted and heated to a red heat while in contact, will weld together. Another discovery was that, when a piece of steel is highly heated and allowed to cool, that, at a certain stage of the cooling, a change takes place, and the piece becomes momentarily hotter and softer than before, and more pliable than at a time when at a much higher temperature. All these discoveries were verified by hundreds of experiments, and the experiments, though in many cases peculiar in their way, were truly scientific, and of a character calculated to give reliable results.

While devoted to the subject of steel, its manufacture and treatment, he was well read in other subjects, astronomy interesting

him greatly. In a lecture to be given on this subject before one of the societies at Johnstown, he wished to make the statement that, "Were it possible to get behind the moon and push it in the direction it is now going, that it would at once begin to go slower," and fearing, as he well might, that it would be questioned, he devised a piece of apparatus to demonstrate it. No piece of apparatus is more interesting than this, nor could one well be made that would better prove the proposition.

Mr. Coffin was married about a year ago to Miss Elizabeth H. Fussell, of Radnor, Pa., and they were living in a new and completely happy home at Moxham, in a valley just off the Conemaugh Valley, where they escaped the immediate results of the great disaster, but which led to a result that brought on fever, and the death of one of the brightest and best of men I ever knew.

He left a devoted wife, a child a few weeks old, an admirer in all who were conversant with his work, and a friend in all who knew him.

To say these things of a young man may both seem too much and be too little; for one to appreciate his genius needed to be with him, and to follow his thoughts as they took shape, and his short cuts to results. Of all the brilliant young men it has been the writer's good fortune to know and be associated with, John Coffin had within him the making of the greatest of them all.

From his life one fact may be learned about college education. Either there is something wrong in the method of conducting examinations which will bar such a man, or else (which may be true) such a man as John Coffin is all the better without it. The education he had given himself, after determining that he wanted it, was tenfold broader and better than that obtained by the great majority of his associates who outstripped him in the examinations.

A Remarkable Railway.

What is in many respects probably the most remarkable railway in the world has recently been opened for traffic in Switzerland, and is described in a recent number of our English contemporary, *Industries*. It is called the Pilatus Railway, taking its name from that of the Alpine peak, which it ascends, and the summit of which is 6,963 feet above the sea level.

The only object in building the line was to afford sight-seers an opportunity of ascending the mountain, which, by climbing, was a very difficult and, to many, an impossible feat. In December, 1885, two Swiss engineers, Colonel Locher and Herr Guyer-Freuler, published a pamphlet containing a fully worked out scheme for the railway, and in 1886 a company was formed and work begun on the construction of the road. The lower terminus of the line is 1,443 feet above sea level, and the upper terminus is within a short distance of the top of the highest peak, the total climb of the line being 5,346 feet, and the total length 15,147 feet. The lowest gradient is 18 per cent., or about 950 feet per mile; the maximum 48 per cent., or 2,534 feet per mile; and the average 35.3 per cent., or 1,863 feet per mile. The line is single, with the exception of a place to allow the passing of the up and down trains, and about half its length is composed of curves, all of the uniform radius of 262.4 feet. There is one stone viaduct of 82 feet span, which occurs on one of the steepest grades, and seven tunnels were made, varying in length from 29 feet to 318 feet. The gauge is 31.5 inches, and there is a central rail, on each side of which there are rack teeth, which were milled from the solid metal, which is mild steel. The axes of the pinions which work in these racks are at a right angle to the surface of the track, and below the rack teeth, on each side of the central rail, is a surface, which is just even with the pitch line, upon which disks which are fixed below and revolve with the pinions have a bearing, thus keeping the pinions engaged at the proper depth, and at the same time dispensing with the necessity for flanges on the wheels, which run on the outer rails. One of the objects of this arrangement is to prevent the possibility of the pinions becoming disengaged from the teeth, or jumping cogs, as it was feared it might if the axes of the pinions were horizontal, and the teeth on top of the rail. There are two pairs of pinions, each having fifteen teeth of a pitch of 3.374 inches.

The rack teeth were first milled in separate pieces of mild steel, each about 10 feet in length, and these are cut while straight, and those to be used on the curves afterward bent to the proper radius. Thus the same number of teeth is obtained on the convex and concave sides of the rail, the pitch being decreased from the normal pitch about .236 inch on the concave side of the rail, and increased a like amount on the convex side. This, however, has been found not to interfere in the practical working. These pieces of rack are riveted to longitudinal girders which are bolted to mild steel sleepers, these in turn being anchored to the masonry which supports the track.

The locomotives were of course specially designed for the line, among the other striking peculiarities possessed by them being a boiler placed across the track, instead of parallel with it, this being done to minimize the disturbance of the water level, due to the different grades. The cylinders are placed parallel with the track, and the rack pinions are driven by bevel gears from the main axles. Some of the principal data of the engines are: Heating surface, 215.3 sq. feet; cylinder diameter, 8.66 inches; stroke, 11.81 inches; steam pressure, 180 lbs. The fractional measurements result from the fact that the dimensions are given by the metric system, and we have transformed them for the convenience of our readers. The weight of the locomotive and car in service is 10.5 tons. Three distinct brakes are provided. There is an air-brake which acts upon all the running wheels of the locomotive and car; a hand-brake acting upon the axles of the locomotive; and a hand and automatic brake acting upon the two upper pinions through the medium of clutches, worm, and worm-wheels. In ascending, the clutches are out of gear, and the worms are at rest, but, when descending, the clutches are in gear, and the worms running at about 300 revolutions per minute. A brake can be applied to the worm-shaft by hand, and an automatic brake acting by centrifugal force is applied when the revolutions exceed 300.

Owing to the difficulty of getting material and workmen up the mountain, the line was built in short sections, these sections, when completed, being made use of for getting up materials for the succeeding sections, this incidentally giving an excellent opportunity for testing the line section by section as the work progressed. Six trips are now made daily in each direction, the time occupied in a journey being 1½ hours.

Export Trade.

United States Consul Mason, at Marseilles, in his report on the American export trade, presents some arguments that are worth consideration. First he gives the opinion of a business man, a native of Holland, who had traveled extensively in the United States. We quote from this man's opinions as follows:

But there is one point in respect to which your countrymen are singularly weak, and that is in the management, or rather lack of management, of their foreign trade. For proof of this, one has to look no further than the fact that your country, with all its magnificent natural resources, its unrivaled manufacturing capacity, and its protective tariff, now imports, each week, more than it exports. Your people ought to be the greatest exporters in the world, but they are not, for the reason, so far as I could see, that they have cared hitherto little or nothing about foreign markets, except periodically as a dumping ground for their surplus products in times of dull trade at home. The difficulty is not about prices. Not only all your food products, but boots and shoes, cotton goods, and an infinite variety of other manufactures are not only as cheap or cheaper, but superior in quality to those of European make. But your people think only of their home trade. Their immense territory, their freedom from international complications, and their lack of a colonial system have made them self-centered and independent, and this has left them what might be termed provincial in a large commercial sense. The hostility of Congress to legislation which might have created merchant steamship lines, and the neglect which has left your consular system practically without revision since before the era of steamships and ocean telegraphs, are simply a reflex of popular indifference to the whole subject of foreign commercial relations. It was an American statesman, I believe, who asked, with fine irony, "What have we to do with abroad?"

The time is coming when your people will change all that. There must be new outlets for their surplus products, or, notwithstanding the country's constant and marvelous growth, their markets will become congested, like ours; and then, with your high-paid labor and free ways of thinking, there may be trouble.

Consul Mason notes the successful efforts of an American firm to do business in Europe, the East Indies and South America, of which he says:

"This company began early and by the right methods, and its foreign trade is enormous, profitable, and secure. It studied the wants of the people in each country and the proper methods of reaching them. It does not send English agents and circulars to France, nor French catalogues to Germany or Spain. It realized at the outset that, in order to do business with a foreign people, it is necessary to adopt the language and methods which prevail in that country.

"It is just here," Consul Mason says, "that the American manufacturer, in his earlier efforts to establish a foreign market for his product, so often fails. He knows that he has a good thing to sell; it has been highly successful at home, and he feels sure that it has only to be offered abroad to be equally appreciated there. He sends to the American consulate a catalogue, a package of circulars (all in English, of course,) and a lithographed letter stating that he has decided to open a foreign trade, and asking that the circulars be distributed among firms in the consul's district who might likely be interested in his machine or product. In many cases the article offered is practically new in the foreign market, designed to supply a popular want which has hitherto been scarcely felt outside the United States.

"The consul, however, distributes the circulars, translates and explains them, and persuades one or more firms in his district to write for further information, particularly in respect to terms. Not infrequently the reply is something like this:

DEAR SIR: Yours of 15th to hand and contents noted. Our terms are 5 per cent. from list f. o. b. cash, or three days' sight on B. L. Yours truly, U. S. & Co.

"The foreign merchant—a Frenchman, let us say—sits down with his lexicon to translate this sententious response, and if he succeeds, which he frequently does not, he feels that, in some way, his inquiry has given offense, and this brusque, laconic reply must have been meant as a rebuke. The letter says just what the American means, but to a person trained in the elaborate and courteous phrascology of French commerce, such economy of words is chilling. But, most important of all, he finds the proposed terms quite out of the question. For a standard article of popular utility, manufactured in his own country, the French merchant may, and often does, pay cash or its equivalent within thirty days of receipt of goods; but as to sending money across the Atlantic to pay in advance for an article that he has never seen, and the sale of which is to be, at best, an experiment, all this is quite out of his line, and the incipient negotiation falls to the ground. Meanwhile his store is thronged with agents of French, Swiss and English firms, eager to place goods in his hands for sale on commission, or to sell to him on terms consistent with the usages of the place, and with all his previous experience."

There seems to be no difficulty about the electric current killing anybody who is not a criminal.—*Providence Journal.*

The new English war-ships prove so deficient in boiler capacity that it is believed some other type of boiler will be used.

Theorizing in Patent Specifications.

The outcome of recent litigation in England, regarding the validity of a patent for a miner's lamp, is not without interest to those who have to do with patents, especially those patents which relate to newly discovered branches of science. The patentee in this case had invented an improvement in miners' lamps, by which the light was nearly doubled without increasing the danger of explosion. It was accomplished by simple modifications in construction, which were made plain in the application for the patent; but in describing it he undertook to explain its action by an entirely erroneous theory, the evidence showing, however, that he did so honestly, believing that he was explaining the true theory of its action. The invention was very successful and profitable, and, as is usual with such inventions, numerous manufacturers infringed upon it, so that the inventor was obliged to go to the courts to maintain his rights. The infringers depended for their defense chiefly upon this false theory of the action of the improvement as set forth in the inventor's application. The court held that if it could have been shown that the erroneous statements had been purposely made to deceive the public regarding the real nature of the invention, or if it had been proven that the erroneous statements, though innocently made, did prevent the mind from understanding the real nature of the invention, then the defense of the infringers would have been successful. But as neither of these things were proven, the patent was held to be valid.

Some points of the same kind came up regarding the winding of a dynamo, where it was proved that the original proposer of the system of winding had not fully understood the principles involved in the action of the machine nor the nature of his invention, yet the publication of his plan, with such detail as enabled dynamos to be so wound, without a full and complete explanation or theory, was sufficient to bar any subsequent patent.

The Practical Engineer, of Manchester, in commenting upon the above cases, states, what is probably equally true in this country:

"In drafting specifications, therefore, it is undoubtedly advisable to avoid theory as much as possible, and to confine descriptive details as closely as possible to the matter in hand, and only carry it far enough to make it thoroughly intelligible. If too much theorizing be indulged in, then it is apt to cause endless discussion and expense in any legal proceedings which may be taken."

Cheap Steel.

According to the Birmingham (Ala.) *Age Herald*, arrangements have been completed for the manufacture of steel by the basic process in that city, thus enabling the low grade irons of the Birmingham district to be worked up into steel by the only process adapted to the purpose. It is evident that great expectations are being based upon this by the people of Birmingham, and many of them declare their belief that their city is destined soon to become the steel center of the United States. While most people outside of Birmingham will be slow to believe that it is to become the principal seat of steel manufacture, there is no doubt that the introduction of the basic process to this country will be an important step in our industrial development, and will give a great impetus to the town which first introduces it. There are, however, other processes for the production of steel, which are coming or are likely to come into use to a greater or less extent, among which may be mentioned the Robert process, first invented we believe in France, and improved upon and introduced into this country by Mr. John W. Bookwalter. This more nearly resembles the Bessemer process, but is capable of producing steel suitable for many purposes at a much lower cost. It has been introduced and is in use in a number of places in the North, and seems likely to prove one of the factors which will prevent Birmingham from having too close a monopoly of cheap steel making.

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FRED J. MILLER, }

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Business Improvement.

It is apparent that there has been a considerable improvement in the general condition of business recently, in which the machinery interests have participated. In most lines of the business the shops are well employed, and there has been recently, and is now, a sufficient demand for iron for immediate use in manufacturing operations to enable prices to be steadily maintained, and to give them an upward tendency. There is also an increased demand for machinists and workmen of associated trades, with a tendency toward better wages. It is true that most of the recent improvement in these respects has been simply a regaining of ground lost within the past year, yet it is a subject for congratulation, especially since there are indications upon which we may base hopes of a steady improvement for some time to come at least. The recent depression in business has all along exhibited some peculiar features, among which none is more peculiar than the fact that the tool builders have not generally suffered from it, but, on the contrary, have in most cases been doing a good business all through it.

The business of the tool builders depends entirely upon the establishment of new industries, and the enlargement or improvement of old ones. In most lines of work in which men are engaged the first demand is for tools, and where machinery of any kind is to be produced, these tools become machine tools. It is therefore said that the condition of the machine tool industry is the best indication of the condition of business in other lines, and it has therefore been a matter for surprise, that, while numerous failures in business and manufacturing enterprises have been reported, and also numerous instances of reductions in wages of employes, the machine tool business has been in the main very good, and, in fact, most of the largest shops have been unusually busy—a singular combination of circumstances, which we believe is without precedent in this country. It is partly to be explained, no doubt, by the greater activity in shipbuilding by and for the government, and to the rapid industrial development of the South.

Reports as to the condition of the crops are in the main quite favorable, and the business which will result from the transportation and marketing of these ought to be sufficient to prevent the stagnation which many have feared, and which, indeed, there seemed a short time ago to be some ground for fearing.

The machine shop owner whose business does not about this time show some little improvement at least, and who cannot find some special reason for it satisfactory to himself, may well begin to examine his ground, to discover if he has not been left behind in the race, and that his competitors, by being better prepared for competition, are slowly but surely driving him to the wall.

A Desirable Combination.

It is, we think, one of the things to be hoped for that the Postmaster-General's efforts in the direction of a combination of the Post Office Department's facilities and the telegraph lines of the Western Union Co. will prove fruitful. One of the points upon which considerable stress was laid during the recent controversy about the rates for government messages, was the cost of delivering messages. Mr. Wanamaker's plan, so far as it has been revealed, is simply to make use of the organization and facilities of the Post Office for the collection and delivery of telegraphic messages, leaving to the telegraph company simply the work of transmitting the telegrams over the wires. This, it is believed, would enable the work to be done much more cheaply than now, and that telegrams could be sent at a cost not much above that of sending "special delivery" letters.

There would seem to be no good reason why the plan should not work and be eminently satisfactory; but already we are informed that the officials of the telegraph company have found a number of serious objections to it, and the indications are that they are not likely to co-operate very heartily in the plan—perhaps from a constitutional dislike of anything which is calculated to reduce the cost of the service to the people. At any rate, as things are now, the company has a monopoly of the entire service, including the collection and delivery of messages as well as their transmission by wire, and though its officers complain of the cost of delivery, the company, of course, collects that cost with a handsome profit from the people, and it is unlikely that a part of its monopoly will be surrendered without ample compensation, unless, indeed, they may be brought to see that some concession is absolutely necessary in order to avoid worse things.

The Interstate Commission has been favored with a petition from nearly 10,000 brakemen, asking that measures be taken to bring about the general use of automatic brakes and couplers on freight cars. We believe that some such action should be taken It has been demonstrated that automatic brakes can be used without trouble on freight trains, and the use of some kind of automatic brake should be enforced. Of course, if this were made compulsory, the usual cry of persecution would go up from railroad companies; but this should not be allowed to have any effect. Every man is restrained by law from doing things that he might like to do, the doing of which might work injury to others, or even to himself, and railroad companies should not be excepted in the general rule that compels people to pay some attention to the rights and safety of others. It would be better if railroad corporations would adopt safety regulations otherwise than by compulsion; but they will not always do this, in which respect they are not particularly different from other corporations, or from individuals, as to that matter.

Jersey City authorities are complaining because of an inundation of people that can find no way of getting a living. The city, it seems, has established some reputation in caring for the unfortunate, and gets, it is thought, more than a fair share of such work to do. But all large cities in this country are getting abundance of this kind of work, which is only what might have been expected from the way the immigrant business has been overdone. The more intelligent class of foreigners understand that there is not likely to be a scarcity of workmen in this country for some years to come; hence, this class has not been coming here to any great extent for two or three years. But the more ignorant class are still impressed with the idea that money lies around loose in the United States; the steamship companies encourage this idea, and until within a year or two they have been assisted by pretty much the entire press of the country. The result is, an army of enforced tramps, and cities over-crowded with men who must be supported by the labor of those who find work; men who in many instances lack the ability or inclination to support themselves anywhere.

Recently a boiler in a sash and blind factory in California exploded, instantly killing four men. The excuse for the explosion given in the press dispatches is that the machinery of the mill was suddenly thrown off. The assumption is that when this was done the steam pressure increased rapidly, the result being that the boiler gave way under the increased pressure. Such an excuse is no excuse at all. There have been safety valves in the market for the past twenty years, sold at a very reasonable price, that will absolutely prevent the accumulation of pressure in a boiler beyond the limit fixed upon. If owners of boilers will not use one of these valves, of which there are several makers, then they should not be excused in case of an accident of this kind.

Spokane Falls, W. T., is getting a lesson in the working of one of the trusts, which are said to be blessings without disguise. The village was pretty thoroughly destroyed by fire a short time since, but with the propensity for going ahead, characteristic of most Western towns, it was in a fair way to rise, materially improved, from its ashes. Now, the makers of brick all about there have formed a trust, and doubled the price of their product, to the great injury of the future prospects of the town. It looks a good deal like a conspiracy to defraud, but it is only a "trust."

No more hearty tribute was paid to the memory of Congressman Cox than the sympathies of the letter carriers of New York and Washington. Mr. Cox, a few years since, took up the cause of the letter carriers, and it was principally due to his efforts that their working and waiting hours were shortened. The fact that these men remember the efforts of Mr. Cox, is creditable to them.

QUESTIONS AND ANSWERS

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(347) J. G. G., St. Augustine, Ill., asks: What should be the lead of the valve for a traction engine 7″x10″, fitted with steel link gear, ports ⅝″ x5″, exhaust port 1¼″x5″, bridges same width as ports? The engine makes 210 revolutions; boiler pressure, 105 pounds; Pickering governor. The lead as the engines come from the shop is 1-32 inch. *A.*—We should think 1-32 inch lead about right.

(348) J. B. L., Charleston, S. C., asks: What pressure per square inch will there be on the bottom of a stand pipe 100 feet high, 12 feet diameter? Give rule. *A.*—The weight of a column of water one inch square and one foot high, is generally reckoned at .434 pounds. Hence, to find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434; the product will be the pressure per square inch. In the example given, the pressure per square inch will be $100 \times .434 = 43.4$ pounds.

(349) W. M. A., Marshall, Texas, asks: Do you consider the valve motion used on locomotives a direct or indirect valve motion? *A.*—See answer to Question 49, in our issue of Feb. 7th, 1889. 2. Suppose a locomotive cuts off at 1½ inches at both ends of the right-hand side cylinder earlier than it does on the left side, how would you determine the difference in the length of the hangers? *A.*—There should not be a difference in the length of the link hangers for any locomotive. If the link hangers are of the same length, the lifting shaft set at right angles to the frames, and all the mechanism in proper alignment, the locomotive must cut at equal distances from the front end of the cylinders, and also at equal distances from the back ends. From the foregoing, it does not follow that the distances cut off from the front ends of cylinders must be equal to the distances cut off from the back ends. To cut off equal portions of steam in the same cylinder, the lifting shaft must not only be in alignment, but it also must be set in a correct position, and not wherever there is room for it. The lifting shaft arms must be of the correct length, and the saddle pin placed in the proper position; but in all cases the link hangers must be of the same length.

(350) T. B., Cleveland, O., asks: What, or how is the allowance found for crank-pins used by engine builders for the different sizes of engines? *A.*—The rules adopted by engine builders for proportioning a crank-pin vary, and often the crank-pin is designed according to the taste and experience of the builder. Even the sizes of a crank-pin found according to rules given by authorities will differ; in fact, there is perhaps no part of an engine so imperfectly understood as the crank-pin. It may, however, be said, that when a crank-pin is so proportioned as not to heat, it is generally strong enough to resist the stresses to which it is subjected, provided the ratio of its length to the diameter is the same as adopted in ordinary practice. To prevent heating, the projected area of the crank-pin, that is, the area obtained by multiplying the length by the diameter, is proportioned in accordance with the pressure on the crank-pin. Observation leads us to believe that, for locomotives, a pressure of 1,600 pounds per square inch of projected area will give good results; for stationary engines, 800 pounds per square inch; and 400 pounds per square inch for marine engines; in paddle-wheel engines this pressure is sometimes increased to 800 pounds. 2. What is the difference, if any, between wrist-pin and crank-pin? Some old engineers claim that both are one; others claim that the wrist-pin is the one which connects the connecting rod to the crosshead. Please answer and quash all discussions. *A.*—Many engineers apply the term "wrist-pin" to the crosshead pin, and a few apply the same term to the crank-pin. In our opinion, the term "wrist-pin" should not be used. The terms "crank-pin" and "crosshead pin" will indicate at once what is meant, and cannot lead to confusion.

(351) T. B., Cleveland, O., writes: Will you please furnish me with the information in regard to the following: 1. How to calculate the steam pressures at different parts of the stroke. Say steam enters at 60 pounds pressure, cut-off at one-half, two-thirds, etc., how can I find the pressures at the different points of the stroke? *A.*—The pressures at the different parts of a stroke when steam is working expansively, can be determined by Boyle's or Mariotte's law. It is as follows: The temperature remaining the same, the volume of a given quantity of gas is inversely as the pressure which it bears; the greater the pressure, the less the volume, and the smaller the pressure, the greater the volume. Hence, when steam is working expansively, we have, according to this law, the volume of the steam at any part of the stroke multiplied by its pressure is equal to a constant number; or if v represents the volume and p the pressure, we have

$v\,p$ = Constant. From this we get $p = \frac{\text{Constant}}{v}$.

If now the steam is cut off at ⅛ of the stroke, and the steam pressure per square inch is 60 pounds, then we have $v = ⅛$ and $p = 60$, and the constant will be $⅛ \times 60 = 20$. If now we wish to find the pressure at half stroke, we have $20 + ½ = 40$ pounds pressure; or, if we wish to find the pressure at ⅞″ stroke, we have $20 + ⅞ = 22.85+$ pounds, and at the end of the stroke we have $20 + 1 = 20$ pounds pressure. In this example the clearance has not been taken into account. If this is to be done, and we designate the clearance by c, we have $(v + c) \times p$ = Constant. From this we get $\frac{\text{Constant}}{v + c} = p$. Thus, for example: Let steam be cut off at ⅛ of the stroke, steam pressure 60 pounds, and clearance 10 per cent., what will be the pressure at half stroke? Here our constant will be $(⅛ + 1\text{-}10) \times 60 = 25.98+$, hence at half stroke the pressure will be

$$\frac{\text{Constant}}{v + c} = p = \frac{25.98}{½ + 1\text{-}10} = \frac{25.98}{.60} = 43.3 \text{ pounds.}$$

At ⅞ stroke the pressure will be

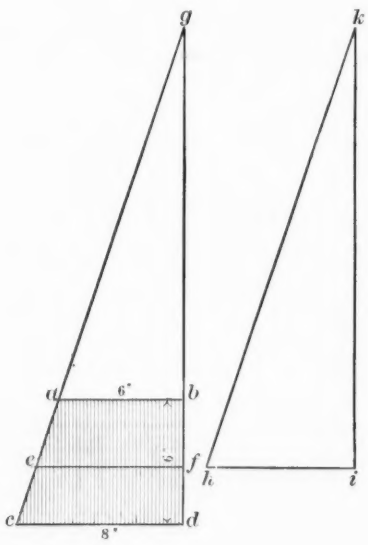
$$\frac{25.98}{⅞ + 1\text{-}10} = \frac{25.98}{.975} = 26.64 \text{ pounds.}$$

And at the end of the stroke the pressure will be

$$\frac{25.98}{1 + 1\text{-}10} = \frac{25.98}{1.1} = 23.61 \text{ pounds.}$$

Notice the difference in the pressures when the clearance is taken into account. These calculations are based on the assumption that the temperature of the steam remains constant throughout the stroke, which is not exactly true; yet the results obtained by the foregoing rules will be close enough for ordinary practical purposes.

(352) S. A. J., Cambria, Pa., writes: I wish to know where to strike a line $e\,f$ in a trapezoid $a\,b\,c\,d$, so as to divide it into two equal parts the line $e\,f$ to be parallel to the line $a\,b$. The length of the side $a\,b = 6$ inches, $c\,d = 8$ inches, and the altitude $b\,d = 6$ inches. *A.*—The distance $f\,d$ cannot be found by any of the simple rules of arithmetic, but we can find it by a very simple process of reasoning. The area of the trapezoid is found by multiing one-half the sum of the parallel sides by the altitude $b\,d$, hence we have



$$\frac{6 + 8}{2} \times 6 = 42 \text{ square inches.}$$

Consequently, one-half of the area, that is the area of $e\,f\,c\,d$ will be $\frac{42}{2} = 21$ square inches. Now let us prolong the lines $c\,a$ and $d\,b$, so as to meet in a point g; we thus obtain a triangle whose altitude is $d\,g$. The object of finding this triangle will soon become apparent. To find the numerical value of $d\,g$, we simply subtract the length of $a\,b$ (= 6 inches) from $c\,d$ (= 8 inches), and thus obtain a remainder of 2 inches. Then, by simple proportion we have $2'' : c\,d :: b\,d : g\,d$; or substituting the numerical values for $c\,d$ and $b\,d$, we have

$$2 : 8 :: 6 : g\,d, \text{ hence}$$

$$g\,d = \frac{8 \times 6}{2} = 24 \text{ inches.}$$

The object of finding this triangle is to establish a ratio between the base $c\,d$ and altitude $g\,d$. Here it will be seen that $c\,d$ is ⅓ of $g\,d$. If, now, this triangle extended only to $e\,f$, then $f\,g$ would be the altitude, and $e\,f$ would again be equal to ⅓ of $f\,g$; and for similar reasons $a\,b$ will be equal to ⅓ of $b\,g$. The area of the triangle $g\,c\,d$ is found by the well-known rule, namely, multiply the base by the altitude, and divide the product by 2; the quotient will be the area. Hence we have $\frac{8 \times 24}{2} = 96$ square inches = area of the triangle $c\,d\,g$. But one-half of the area of the given trapezoid is 21 square inches; subtracting this from the area of the triangle $c\,d\,g$, we have $96 - 21 = 75$ square inches. Let $h\,i\,k$ represent a triangle similar to $c\,d\,g$, and having an area of 75 square inches. Now, since the triangle is similar to $c\,d\,g$, we know that $h\,i$ is equal to ⅓ of $i\,k$. Since we do not know the length of the base $h\,i$, let us represent this length by the letter x; then $k\,i$ will be equal to $3x$. Now we know that by multiplying the base by the altitude and dividing the product by 2, we obtain a quotient which is equal to the area; we may therefore represent the conditions of the triangle $h\,i\,k$ by the following expression.

$$\frac{x \times 3x}{2} = 75 \text{ square inches,}$$

or, what amounts to the same thing,

$$\frac{3\,x^2}{2} = 75 \text{ square inches.}$$

In order to surpress the fraction on left side of the equation, we multiply both sides by 2, and thus obtain $3\,x^2 = 150$. Dividing both sides of the equation by 3, we have $x^2 = 50$. Consequently,

$$x = \sqrt{50} = 7.071 \text{ inches.}$$

But x is the length of the base $h\,i$, and we know that $i\,k$ must be equal to three times $h\,i$; hence, $i\,k = 7.071 \times 3 = 21.213$ inches. Lastly, subtracting $i\,k$ from $d\,g$, we have $24 - 21.213 = 2.787$ inches, which is the distance from f to d; therefore a line $e\,f$ drawn 2.787 inches above the base $c\,d$, and parallel to it, will divide the trapezoid into two equal areas.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.

Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

25″ Upright Drills. J. E. Snyder, Worcester, Mass.

28″ Upright Drills. J. E. Snyder, Worcester, Mass.

32″ Upright Drills. J. E. Snyder, Worcester, Mass.

36″ Upright Drills. J. E. Snyder, Worcester, Mass.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"The Bulldozer," a new departure; forging by pressure. M'f'd by Williams, White & Co., Moline, Ill.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton & Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 131 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Bit Brace Die Holders and Bit Brace Taps. S. W. Card & Co., Mansfield, Mass.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

R. G. Du Bois, 715 11th St., Washington, D. C. Procures first class patents on inventions. Write.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Sept. 12, p. 13. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Portable Key-seating Machines and Stub Ends for small connections, address T. C. Dill Machine Co., 726 Girard ave., Philadelphia, Pa.

The best emery wheel made is the "Norwich." For particulars send to Montgomery & Co., 105 Fulton st., New York.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches, working drawings for the transmission of power by steam, water, air and electricity.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

Am building new foundry and machine shops, and want catalogues of machine tools, foundry appliances, and wood-working mach'y. Also wish to arrange for general agency of engines, boilers, belting, cane mills, and other mach'y required in a live country. P. J. Plunkett, Station A, Springfield, Mo.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't Delamater Iron Works, will hereafter manufacture the Delamater Screw Propeller.
Propellers of same pattern and workmanship as formerly made by the Delamater Iron Works. Each designed for its special work at lowest prices.
Consulting Expert and Constructing Engineer.
Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

C. H. De Lamater & Co., New York, have for sale a very desirable lot of machinery and fixtures for Pattern Makers, Brass Founders, Machinists, Riggers, Blacksmiths and Boiler Makers; also stock of boiler iron, plate iron, sheet iron, patterns and pattern lumber, sand and clay, pipe and pipe fittings, shafting, hangers, iron and wood pulleys, belting, bolts, nuts, washers, screws, nails, packing, flasks, and the necessary small tools for iron and brass founders.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including August 29, 1889 issue, 84 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 98 articles have thus far appeared up to and including the August 22, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

MANUFACTURES

C. W. Wilder & Co. will build a silk factory at Fredericksburg, Va.

The Narragansett Mill, at Fall River, Mass., will put in a new steam plant.

The Glastonbury Knitting Co. will build a factory 52x111 feet, at Manchester, Conn.

The planing mill of J. H. Short, recently burned at Baltimore, Md., will be rebuilt.

W. Snyder, of Philadelphia, expects to build a knitting mill at some point in Virginia.

The Waynesburg (Pa.) Electric Light Co. has purchased land upon which to erect a plant.

The Florence Planing Mill Co. has increased its capital stock, and will enlarge the works.

An addition will be built, doubling the capacity of the Lebanon Iron Works, Lebanon, Pa.

The Louisville, St. Louis & Texas Railroad Co. will rebuild their machine shops, recently burned.

It is said that the Franconia (N. H.) Iron Works, which have been idle since 1862, will be started soon.

The Triumph Compound Engine Co. are fitting up a shop at Cincinnati, Ohio, in which to build engines.

The West Duluth (Minn.) Manufacturing Co. has been incorporated, to manufacture sash, doors and blinds.

The Georgia Midland & Gulf Railroad Co. will enlarge their machine shops and roundhouse at Columbus, Ga.

The State Farmers' Alliance have decided to build a plow factory at Vesuvius, a suburb of Montgomery, Ala.

The Hampden Envelope Company has been organized, and it is expected that shops will be built at South Hadley, Mass.

The Fullerton (Neb.) Flouring Mill, lately burned, will probably be rebuilt, the company securing assistance from the town.

The Vicken & Kneble Machinery Company has been organized, to manufacture wood-carving machinery at Birmingham, Ala.

The Oil City (Pa.) Boiler Works is to add a foundry to its already extensive works, and will shortly be prepared to supply machine castings of various kinds.

The Anchor Flour Mills, Fort Worth, Texas, is to double its capacity by the addition of new machinery, and an elevator of 85,000 bushels capacity is to be built.

R. D. Nuttall & Co., Allegheny, Pa., have been remodeling their plant, preparatory to going into the manufacture of machinists' tools, dies, special machines, etc.

Henry R. Worthington, New York, is to furnish the City of Nashville, Tenn., with a 10,000,000 gallon pumping engine. It will be a high-duty engine of the vertical type.

The Sweetwater Mill & Gin Co., Sweetwater, Texas, owns a plant worth $2,000, which they will give to any one who will build a 50-barrel roller flour mill at that place.

Clark & Cole, who lately bought land at Middleboro, Mass., will at once begin the construction of a factory 75x45 feet, on the ground, and it will be used in the manufacture of boxes.

J. B. Steele, S. S. Fraser and A. A. Springs have incorporated the Georgetown Lumber and Manufacturing Company, at Georgetown, S. C. Lumber, furniture and woodenware will be manufactured.

The forge works of the Duff Co. will be moved from Troy, Ohio, to West Superior, Wis. The company gets a gift of land valued at $15,000, and $5,000 in money. Marine boiler work and heavy forgings.

Cheeny & Bigelow, of Springfield, Mass., manufacturers of wire cloth, have begun to erect a new brick building corner of Taylor and Dwight streets in that city. The building will be 50x150 feet, and four stories high.

The citizens of Morris, Ill., have called a special election for the purpose of voting on the proposition to bond the city in the sum of $100,000. The money is to be used to encourage manufacturing enterprises in that city.

Bids for the construction of the machine and repair shops of the Mississippi Valley Road at Vicksburg will soon be advertised for. The plans have been approved by President Wilson, and are for shops 1,200 feet in length, to cost about $100,000.

Nicholson & Waterman, Providence, R. I., distribute a small pamphlet, in which is set forth the utility of horizontal boring machines in machine shop practice; the construction and operation of a boring machine made by them is also explained.

The Energy Manufacturing Co., Philadelphia, Pa., have issued a new catalogue of hand power hoisting machinery and rigs, center grinders, clamping blocks, drill rests, etc. The catalogue is illustrated, and contains descriptions of the machinery made by them.

The North Carolina Lumber Company has been incorporated at Tillery, N. C., by N. McRae Robinson, H. H. Fries and W. W. Richards, of New York city, who have bought S. R. Tillery's dry kiln and 2,500 acres of timber land. They will build a sash, door and blind factory, and a railroad.

The Board of Trade of St. Cloud, Minn., will give an Ohio syndicate a bonus of $10,000 for the location at that city of a $100,000 vulcanized fiber works for the manufacture of tubs, pails, etc. They propose to employ 100 men, and to have a daily capacity of 1,000 pails, 500 tubs, and 250 sinks, and guarantee to run ten years.

A large blast furnace will shortly be erected in Toronto, Ontario, at a cost of about $200,000. This will, it is believed, be only one of a number that will be put down in Canada. The Canadian Government is desirous of building up the iron industry of that country, and is believed to be backing a syndicate of ironmasters.

P. J. Plunkett, Station A, Springfield, Mo., writes us that he is building in that city a foundry 120x40 feet, and machine shop 60x40x20 feet, to be completed by October 1st, and stocked with a full line of machine tools, foundry appliances, and wood-working machinery. He formerly owned a foundry and machine shop at Tyler, Texas.

The French River Boom Company will be incorporated at Toronto, Ont., with a capital stock of $100,000, by H. H. Cook, H. J. Bohme, F. E. MacDonald, of Toronto; C. Henderson, of Bracebridge, and N. Irvine, of French River. The company will carry on a general lumber business, improve the French River and its tributaries, and build mills.

The Chicago Spring Butt Co., Lake and Union streets, informs us that they will shortly commence the erection of a large business block for their own use, the interior of which will be arranged for the production of their specialties, which are spring hinges and butts of all sizes in iron, brass, and bronze metals. This arrangement has been made necessary on account of their largely increasing trade, which has entirely outgrown the capacity of their present contracted factory.—*Industrial World.*

The Bromley Manufacturing Company have commenced at Philadelphia, Pa., the erection of what will be the largest curtain and upholstery mill in the trade when completed. It will have a frontage of 60 feet, run back a distance of 300 feet, and will be five stories and basement high, and will be constructed of brick. The company state that, although the production of their present plant is increasing steadily, and new machinery is being put in as fast as it can be made, it is inadequate to fill their orders.

The *Bath Independent* says: At the south division of the Bath [Maine] Iron Works, which, by the way, now ranks first of the machine shops in the State, the boys have had for several days to work all day and all night, including mid-day hours. The rush has been partly due to the additional work on the tug "Ice King." Last Saturday the tanks which were being rushed for Carlton, Norwood & Co., of Rockport, were not quite completed by noon, so they were placed on box cars, and a force of boiler makers from the shop put on board the cars also. The train left town in this fashion, the Works thus completing the tanks "on time." This hammering tanks while whizzing o'er the rail is a new departure in Maine machine work enterprise.

Much interest is felt in the success of the new invention of Mr. Allen, of Tuscaloosa, Ala., which, it is claimed, will spin cotton from the seed, without going through the process of ginning, arranging the fiber, etc. It is apparent that, if this invention proves successful, it will not only be an important and valuable one in reducing the expense of manufacturing cotton, but it will hasten the transfer of the cotton mills of the country to the cotton-producing region. The mills would then take the cotton in the seed without ginning or baling. The transportation of seed cotton to a distance would be so heavy an expense as to give a great advantage to mills that could obtain it from their immediate neighborhood.—*Atlanta Journal.*

Machinists' Supplies and Iron.

NEW YORK, Sept. 14, 1889.

Iron—American Pig.—No important change has taken place in the situation, and trade has been fairly active, with a steady market. Contracts previously made are taking about all the iron produced by Northern furnaces. We quote, Standard Northern brands, No 1 X Foundry, $17 to $18; No. 2, $16 to $17. Southern brands, No. 1, $16.75 to $17.25; No 2, $16 to $16 50. Northern brands, Grey Forge, $15 25; Southern brands, $15.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Wanted—A good mech. draftsman for gen. work: state exp., salary, etc. Lock Box 96, Steelton, Pa.

To engine builders in need of a good superintendent. Address Box 23, AMERICAN MACHINIST.

Wanted A good mechanical draftsman on general engine and boiler work. State experience and salary expected. Address F. M., AMERICAN MACHINIST.

Wanted—Foreman for shop making iron pipe fittings, iron valves, radiators, and steam-heating specialties. "Manufacturer," AMERICAN MACHINIST.

Wanted—Position by a first-class mechanical draftsman; 16 years' experience on general machinery. Address BOX 21, AMERICAN MACHINIST.

A machinist of 25 years' experience, 10 years as foreman, wants position; can give reference if required. Address Lock-box 21, Anoka, Minn.

Wanted—Position as mech. draftsman, either in machine shop or as assistant for a mechanical engineer. Address Box 22, AMERICAN MACHINIST.

Wanted—A first-class millwright; one competent to make drawings and patterns. Competent, AMERICAN MACHINIST.

Wanted—Foreman boiler maker; must be steady and thoroughly understand his business. Send ref. and exp. Address Boiler Maker, AM. MACHINIST.

Wanted—15 good machinists can find steady work at Jones & Lamson Machine Co.'s new shop at Springfield, Vt.

Wanted—A mechanical draftsman with a practical knowledge of foundry and machine shop work. Box 93, Albany, N. Y.

A mech. engineer, widely exp'd in designing, estimating, m'f'g, superinten'g, etc., is open for engagement in any location. "Nom," Box 321, Chicago, Ill.

Mechanical engineer desires position; 15 years in charge of building and designing engines. Address Box 24, AMERICAN MACHINIST.

Wanted—A situation as foreman of a small foundry employing 3 to 6 men (country preferred), by a good moulder, American, of strictly temperate habits; had 25 years' exp. C. C., AM. MACHINIST.

Wanted—A wrought-iron worker; a man who thoroughly understands wrought-iron, making grilles, stoop railings, etc. Address, stating previous experience, M. Mahony, Troy, N. Y.

A young man, age 25, tech. school graduate, 9 years' mfg. and designing exp. on steam engs., pumping and dredging mach'y, wishes situation, N. Y. city or vicinity pref'd.; best refs. "G. A.," AM. MACH.

Wanted—A foreman; a good blacksmith, accustomed to the care of a shop, and experienced in the use of forging machines for forging small articles. State age and experience. R. C., AM. MACHINIST.

Foreman moulder wanted; one who is a good, energetic mechanic, understands his business, and capable of handling from 25 to 40 men on heavy engine and mill castings. H., AMERICAN MACHINIST.

Wanted—Foundry foreman. Must be thoroughly competent to take charge of foundry and handle men to good advantage. Address, giving references, and state class of work you have been accustomed to doing, "Foundry," AMERICAN MACHINIST.

Wanted—A skilled mechanic for foreman; must be a thorough modern workman of extensive practical and scientific experience; fine tool and construction work, requiring accuracy and knowledge of "short cuts." Good opening for the right man; state exp., refs., etc. Mech. Supt., AM. MACHINIST.

Wanted—Two thorough, practical mechanics; one as supt. of machine shop and one as supt. of moulding shop, in iron works doing a general foundry and machine business. To the right parties, having a few thousand dollars to invest, an interest will be given. Address T., care AMERICAN MACHINIST.

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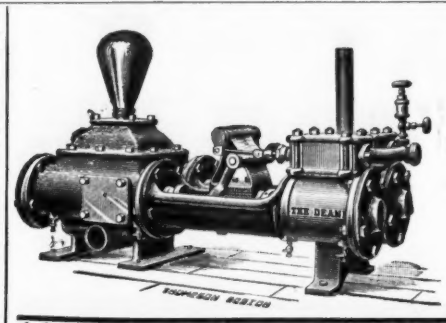

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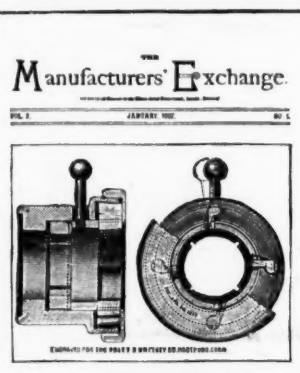

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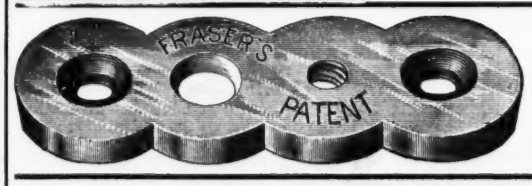

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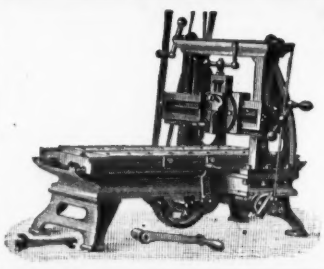

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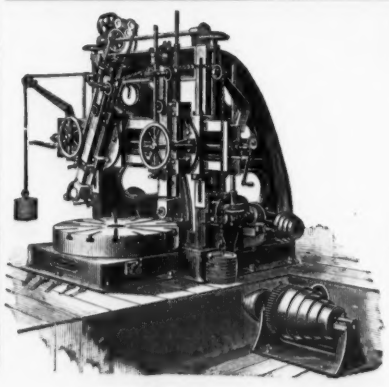

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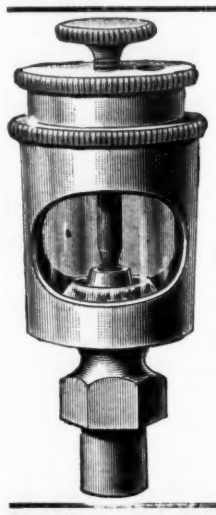

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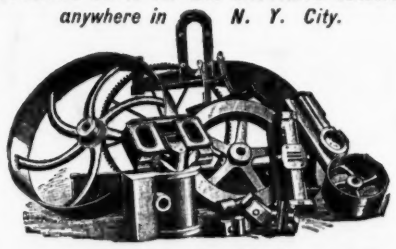

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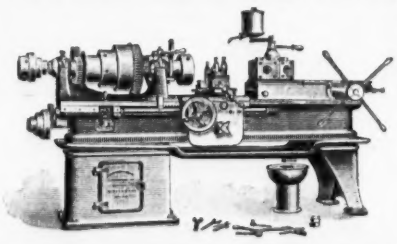

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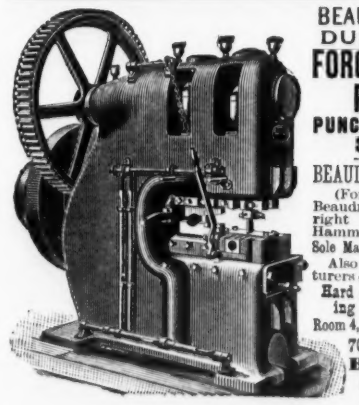

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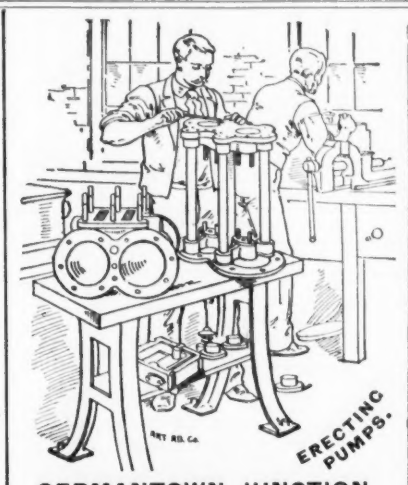

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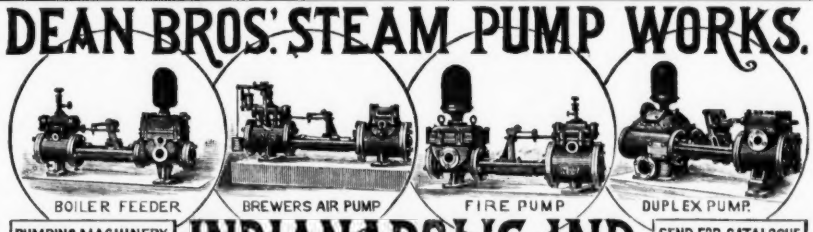

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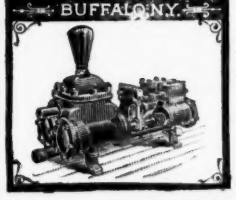

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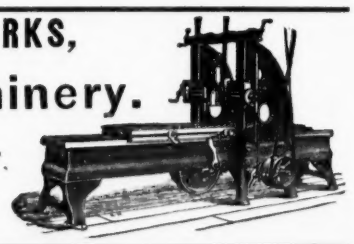

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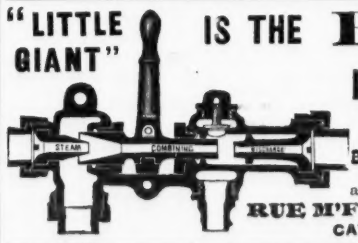

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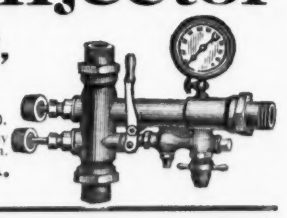

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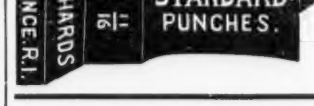

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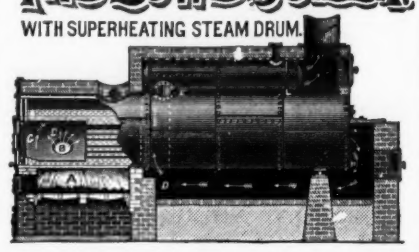

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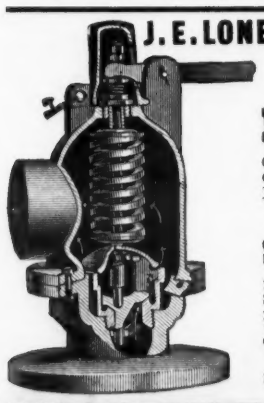

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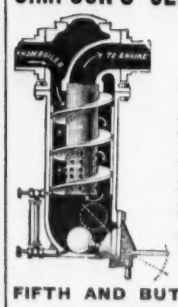

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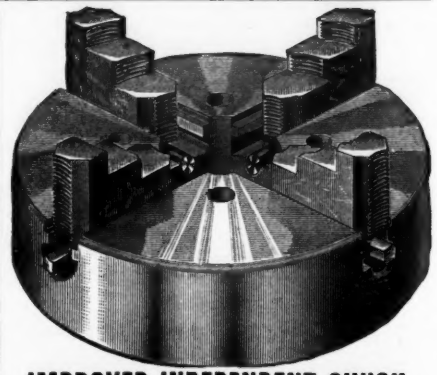

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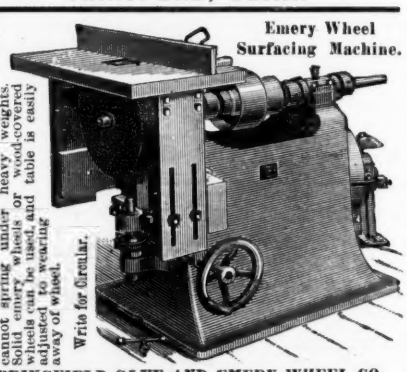

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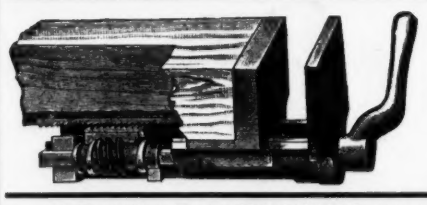

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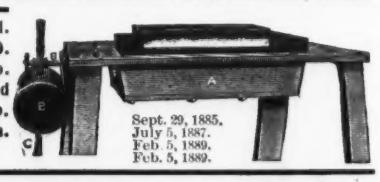

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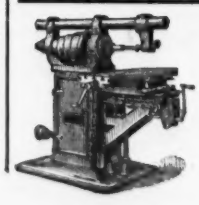

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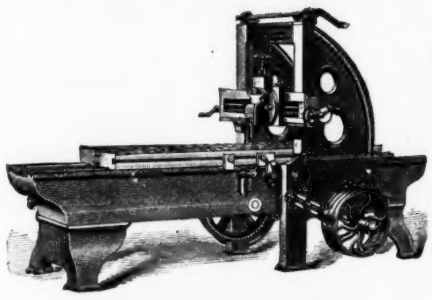

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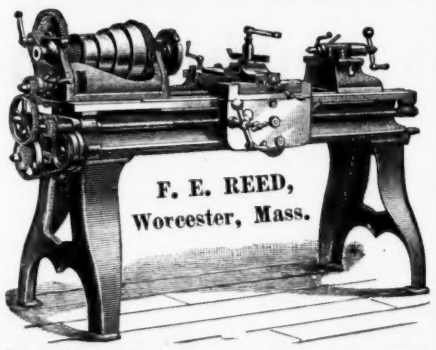

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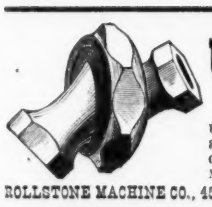

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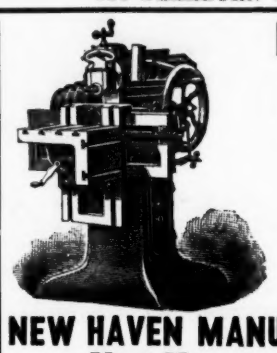

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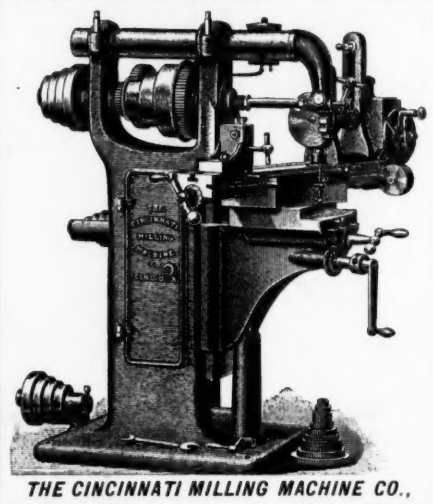

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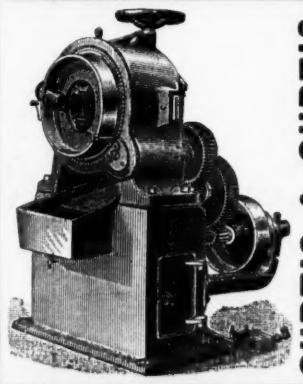

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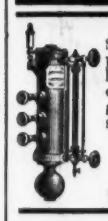

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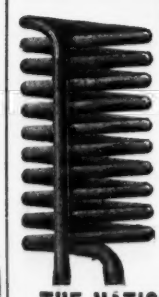

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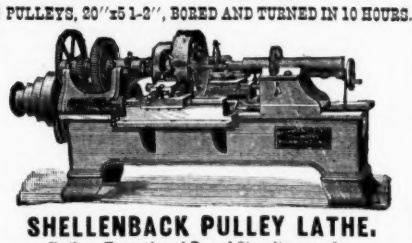

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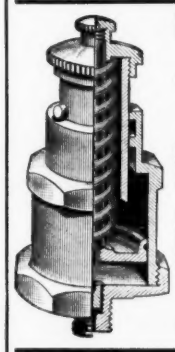

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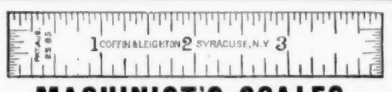

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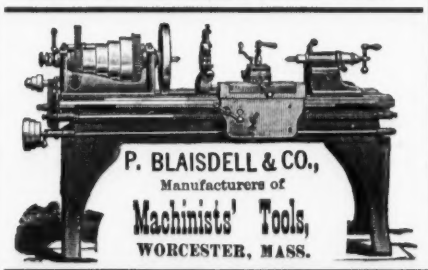

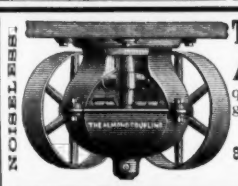

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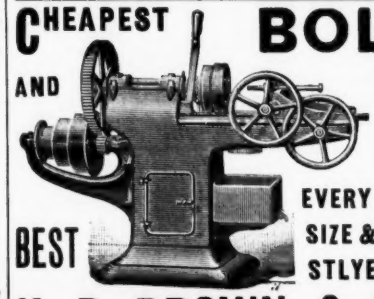

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1	15 in. x 6 ft.	" "	Lathe & Morse,	good.
1	16 in. x 6 ft.	" "	Shawmut,	good.
1	16 in. x 6 ft.	" "	Hendey,	new.
1	16 in. x 8 ft.	" "	Hendey,	new.
1	17 in. x 8 ft.	" "	Fitchburg,	good.
2	18 in. x 8 ft.	" "	Star Tool Co.,	good.
1	19 in. x 7 ft.	" "	Light Pattern,	good.
1	20 in. x 10 ft.	" "	Fitchburg,	A 1.
1	22 in. x 10 ft.	" "	Fitchburg,	A 1.
1	24 in. x 10 ft.	" "	Fitchburg,	A 1.
1	24 in. x 12 ft.	" "	Fitchburg,	A 1.
1	31 in. x 20 ft.	" "	L. W. Pond,	fair.
1	32 in. raised to 39 in. x 16 ft.		Eng. Lathe, Ohl, late pattern,	A 1
1	54 in. x 20 ft.	Engine Lathe,	Fitchburg,	new.
1	No. 2 Cabinet Turret,		American Tool Co.,	A 1.
1	14 in. Trav Head Shaper,		Fitchburg,	new.
1	10 in. Shaper,		Fitchburg,	A 1.
1	26 in.	"	Lodge, Davis & Co.,	new.
1	22 in. x 5 ft. light pat. Planer,		Putnam,	good.
1	25x8	"	Fitchburg,	A 1.
1	30x16	"	"	A 1.
1	42x12	"	"	A 1.
1	60x55x24	"	"	A 1.
1	26 in. Pulley Machine, 1 head.		Stevens,	good.
1	36 in.	"	"	good.
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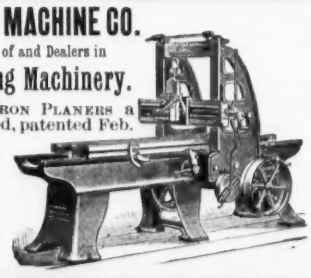

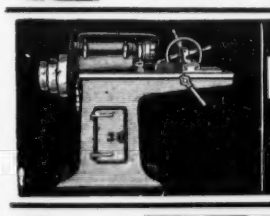

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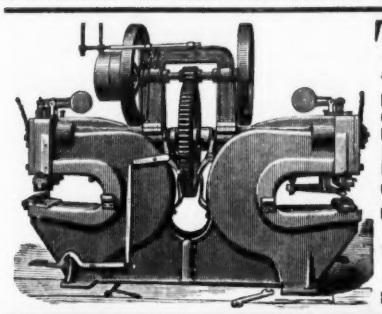

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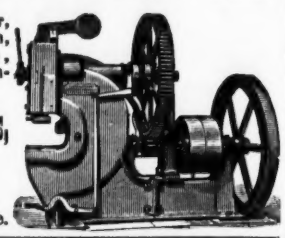

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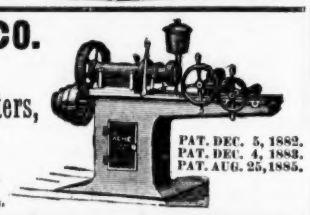

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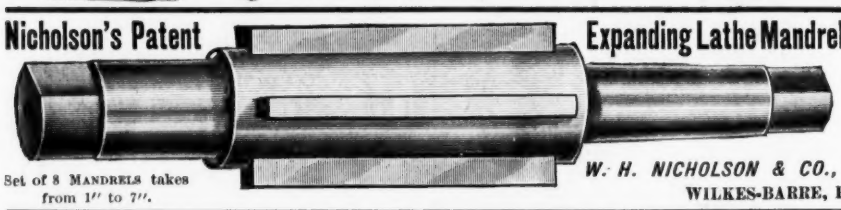

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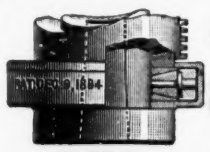

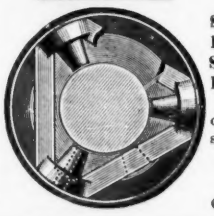

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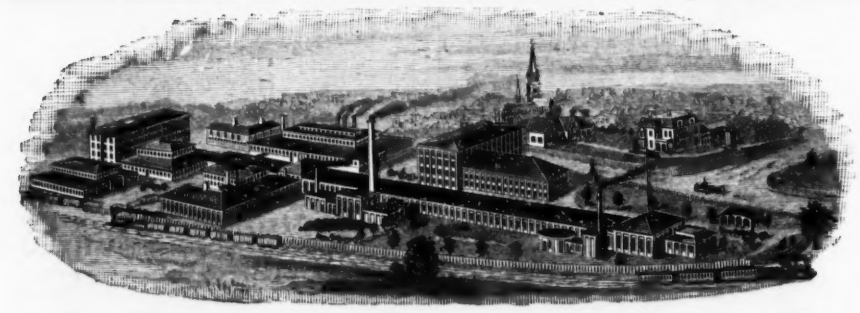

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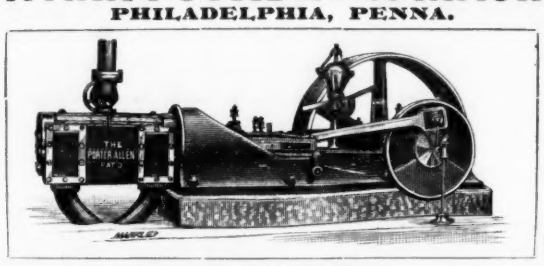

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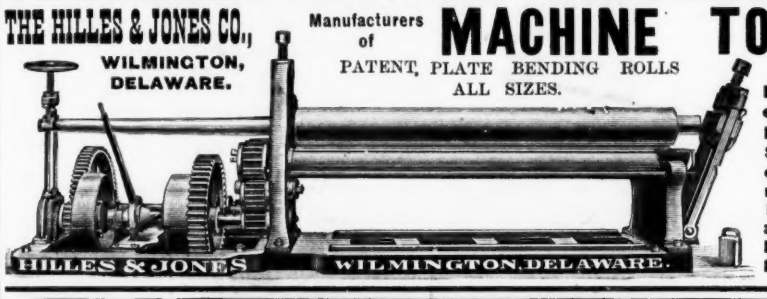

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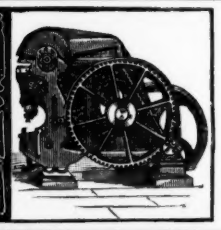

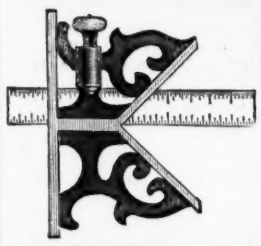

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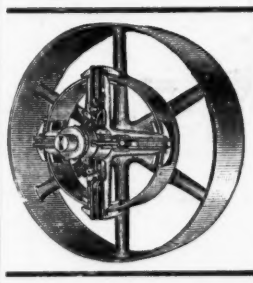

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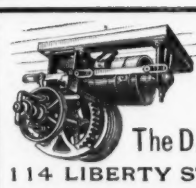

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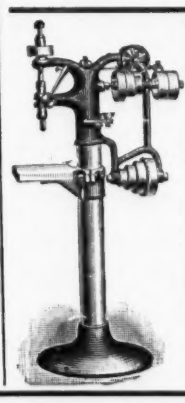

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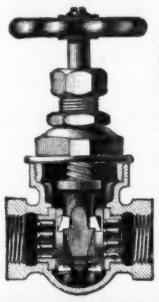

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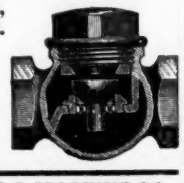

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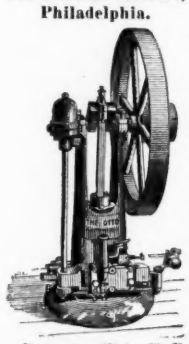

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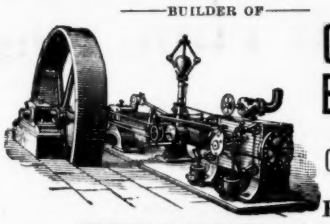

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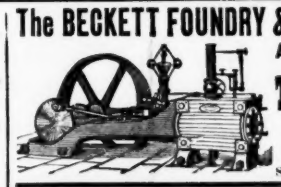

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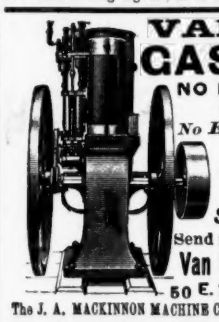

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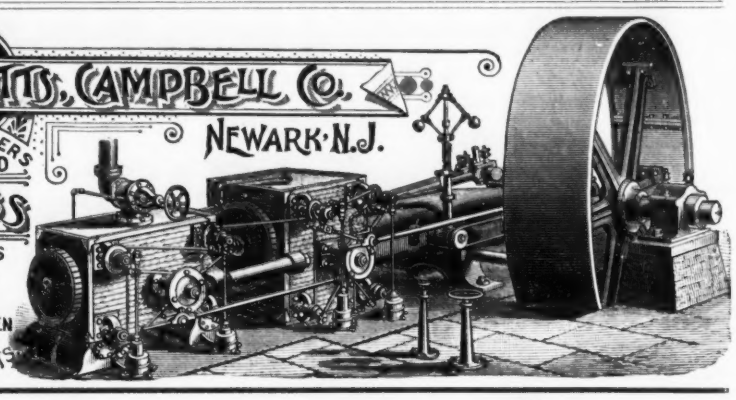

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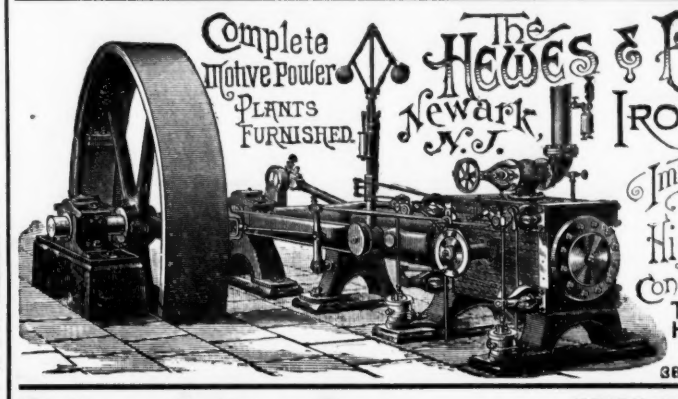

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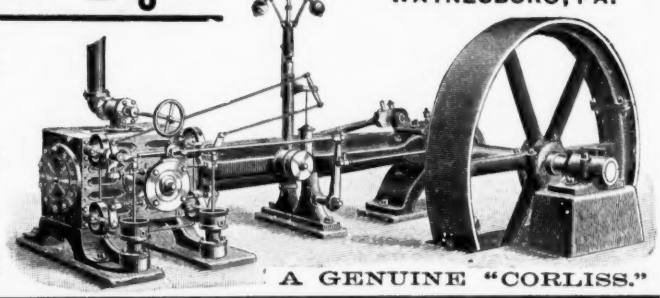

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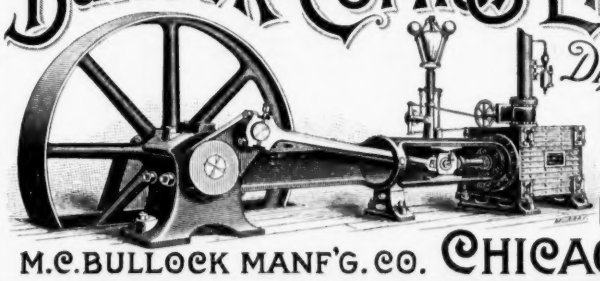

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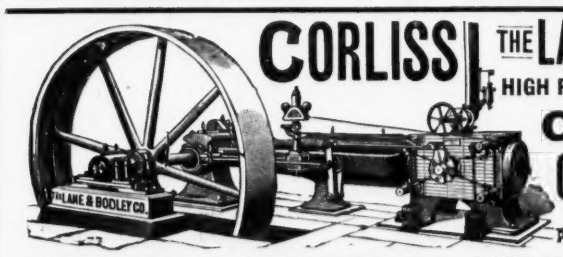

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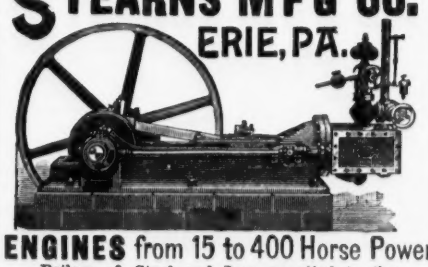

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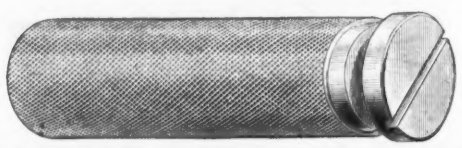

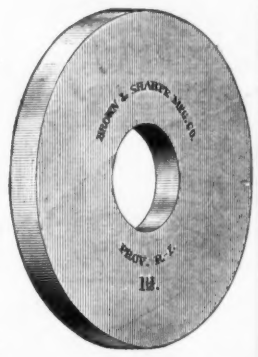

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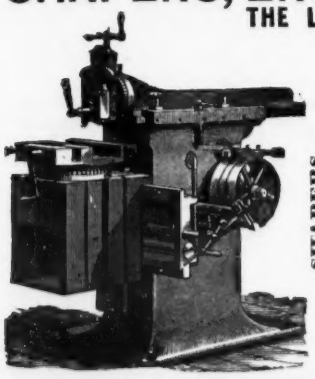

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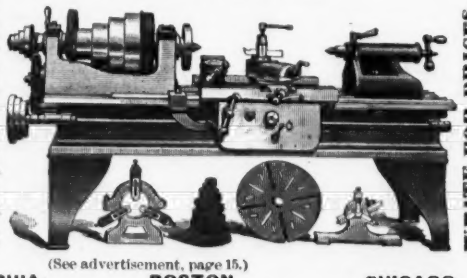

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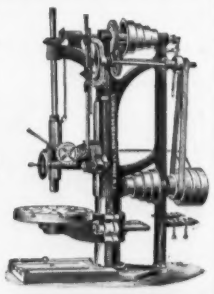

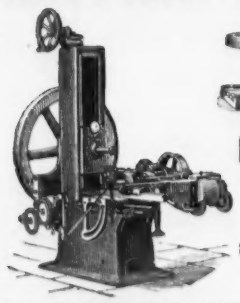

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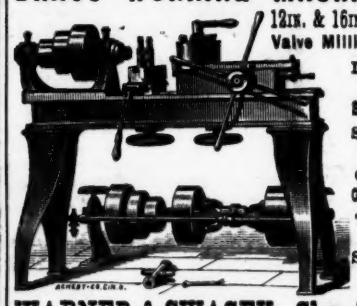

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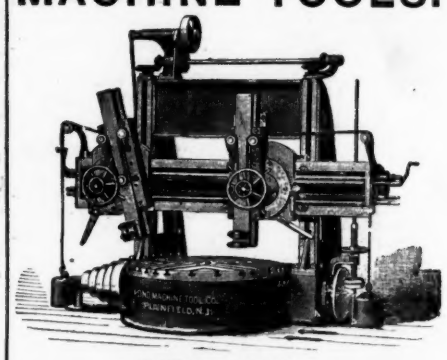

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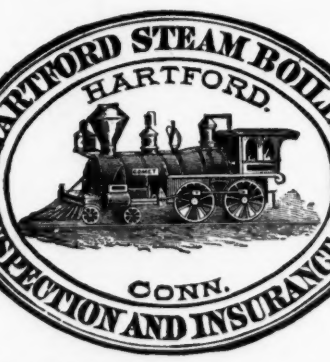

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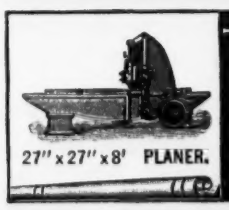

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